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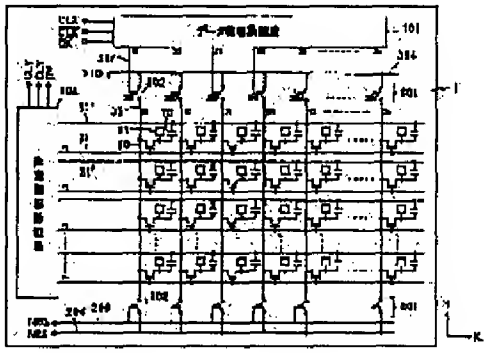
(54) ACTIVE MATRIX SUBSTRATE, LIQUID CRYSTAL DEVICE AND ELECTRONIC EQUIPMENT, AND METHOD FOR INSPECTING THE SAME ACTIVE MATRIX SUBSTRATE

(57)Abstract:

PROBLEM TO BE SOLVED: To actualize an inspecting function and a precharging function in a narrow area on an active matrix substrate prepared by forming scanning lines, data lines, TFTs, etc., thereon to constitute a liquid crystal device.

SOLUTION: An active matrix substrate is equipped with a data line driving circuit 101 provided on one end side of data lines 35, and an inspecting and precharging circuit 201 which is provided on the other end side and supplies an inspection signal to the data lines at the time of inspection performed before the liquid crystal device is assembled and a precharge signal to the data lines during normal operation.



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CLAIMS

[Claim(s)]
[Claim 1] The active-matrix substrate for constituting the liquid crystal equipment with which it comes to pinch liquid crystal between the substrates of a couple characterized by providing the following. Two or more scanning line and two or more data lines which carry out phase intersection on one substrate of the substrates of the aforementioned couple. The scanning-line drive circuit which supplies a scanning signal to two or more aforementioned scanning lines. A picture signal supply means to be prepared in the end side of two or more aforementioned data lines, and to supply a picture signal to two or more aforementioned data lines. Two or more pixel sections by which an activity drive is carried out based on the aforementioned scanning signal and the aforementioned picture signal which are established in the shape of a matrix and supplied through two or more aforementioned scanning lines and two or more aforementioned data lines, respectively, The precharge [inspection-cum-] circuit which precedes the precharge signal of a predetermined voltage level with the aforementioned picture signal at the time of normal operation, and is supplied to two or more aforementioned data lines, respectively while being prepared in the other end side of two or more aforementioned data lines and supplying an inspection signal to two or more aforementioned data lines at least, respectively at the time of inspection.
[Claim 2] The aforementioned precharge [inspection-cum-] circuit It is constituted including two or more precharge switches which carry out the switching output of the precharge signal inputted through a precharge signal line according to a precharge circuit driving signal, respectively, and are supplied to two or more aforementioned data lines as the aforementioned inspection signal or the aforementioned precharge signal, respectively. A sampling circuit with two or more sampling switches which the aforementioned picture signal supply means samples the picture signal inputted through a picture signal line according to a sampling circuit driving signal, respectively, and are supplied to two or more aforementioned data lines as the aforementioned picture signal, respectively, The active-matrix substrate according to claim 1 characterized by being constituted including the data-line drive circuit which supplies the aforementioned sampling circuit driving signal to two or more aforementioned sampling switches, respectively.
[Claim 3] Two or more aforementioned precharge switches are active-matrix substrates according to claim 2 characterized by the bird clapper from the TFT by which the aforementioned data line was connected to the source electrode, the aforementioned precharge signal line was connected to the drain electrode, and the aforementioned precharge circuit driving-signal line was connected to the gate electrode, respectively.
[Claim 4] The aforementioned TFT is an active-matrix substrate according to claim 3 characterized by the bird clapper from one of an N channel type transistor, a P channel type transistor, and complementary transistors.
[Claim 5] The shift register of one sequence with which the aforementioned data-line drive circuit outputs a transfer signal one by one from each stage, So that the aforementioned transfer signal outputted almost simultaneously from two stages in this shift register which adjoin each other may not lap mutually in time An active-matrix substrate given in any 1 term of the claims 2-4 characterized by having the wave control circuit outputted as the aforementioned sampling circuit driving signal after restricting the time length of the aforementioned transfer signal.
[Claim 6] Two or more aforementioned pixel sections are active-matrix substrates given in any 1 term of the claims 1-5 characterized by being constituted including the TFT for an active drive and the aforementioned precharge [inspection-cum-] circuit consisting of same films as the TFT of the aforementioned pixel section including the TFT formed simultaneously, respectively.
[Claim 7] Liquid crystal equipment characterized by equipping any 1 term of claims 1-6 with the active-matrix substrate of a publication, the substrate of another side of the substrates of the aforementioned couple, and the aforementioned liquid crystal.
[Claim 8] The seal member which sticks the substrate of the aforementioned couple in the circumference of the screen-display field specified by two or more aforementioned pixel sections, and surrounds the aforementioned liquid crystal,

It has further circumference abandonment of the shading nature formed along with the profile of the aforementioned screen-display field at the substrate of aforementioned another side between the aforementioned seal member and the aforementioned screen-display field. Liquid crystal equipment according to claim 7 characterized by being prepared in the position where at least one side of the I/O wiring of the aforementioned precharge [inspection-cum-] circuit and the aforementioned precharge [inspection-cum-] circuit counters the aforementioned circumference abandonment.
[Claim 9] Electronic equipment characterized by having liquid crystal equipment according to claim 8.
[Claim 10] Making two or more aforementioned precharge switches of all into an ON state, while being the inspection method of the active-matrix substrate a publication and carrying out normal operation of the (i) aforementioned data-line drive circuit to claims 2-6 measuring the current which impresses predetermined voltage to the aforementioned precharge signal line, and flows on the aforementioned picture signal line -- or (ii) Making into an ON state two or more precharge switches of all simultaneously driven by the aforementioned precharge circuit driving signal, while carrying out normal operation of the aforementioned data-line drive circuit The inspection method of the active-matrix substrate characterized by conducting opening or open-circuit inspection of two or more aforementioned data lines by measuring the current which impresses predetermined voltage to the aforementioned picture signal line, and flows to the aforementioned precharge signal line.
[Claim 11] Making two or more aforementioned precharge switches of all into an OFF state, while being the inspection method of an active-matrix substrate given in claims 2-6 and making all the (i) aforementioned sampling switches into an ON state measuring the current which flows between the picture signal lines by which electrical installation is carried out to the data line which impresses predetermined voltage and this adjoins each other between the picture signal lines by which electrical installation is carried out to the data line which adjoins each other -- or (ii) Making two or more aforementioned precharge switches of all into an ON state, while making all the aforementioned sampling switches into an OFF state By measuring the current which flows between the precharge signal lines by which electrical installation is carried out to the data line which impresses predetermined voltage and this adjoins each other between the precharge signal lines by which electrical installation is carried out to the data line which adjoins each other The inspection method of the active-matrix substrate characterized by conducting shunt evaluation of two or more aforementioned data lines.
[Claim 12] Making two or more aforementioned precharge switches of all into an ON state, while being the inspection method of an active-matrix substrate given in claims 2-6 and making all the (i) aforementioned sampling switches into an OFF state measuring the current which impresses predetermined voltage to the aforementioned precharge signal line, and flows on the aforementioned picture signal line -- or (ii) Making into an ON state two or more precharge switches of all simultaneously driven by the aforementioned precharge circuit driving signal, while making all the aforementioned sampling switches into an OFF state The inspection method of the active-matrix substrate characterized by conducting leak inspection of the aforementioned sampling switch by measuring the current which impresses predetermined voltage to the aforementioned picture signal line, and flows to the aforementioned precharge signal line.
[Claim 13] Making two or more aforementioned precharge switches of all into an OFF state, while being the inspection method of an active-matrix substrate given in claims 2-6 and making all the (i) aforementioned sampling switches into an ON state measuring the current which impresses predetermined voltage to the aforementioned precharge signal line, and flows on the aforementioned picture signal line -- or (ii) by measuring the current which impresses predetermined voltage to the aforementioned picture signal line, and flows to the aforementioned precharge signal line, making two or more aforementioned precharge switches of all into an OFF state, while making all the aforementioned sampling switches into an ON state The inspection method of the active-matrix substrate characterized by conducting leak inspection of the aforementioned precharge switch.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention by forming driver elements, such as various wiring, such as the scanning line and the data line, and TFT (TFT being called suitably below), etc. on the substrate, and pinching liquid crystal between opposite substrates The active-matrix substrate which constitutes the liquid crystal equipment of an active-matrix drive method etc., It belongs to the technical field of liquid crystal equipment equipped with this, electronic equipment, and various kinds of electrical property inspection methods in such an active-matrix substrate. It belongs to technical fields, such as an active-matrix substrate of form that circumference circuits, such as a precharge circuit and an inspection circuit, are especially formed on a substrate.
[0002]
[Description of the Prior Art] It is common that much pixel electrodes and TFT are conventionally prepared on a glass substrate corresponding to the scanning line, the data lines, and each of these intersections of a large number arranged in all directions, respectively in the active-matrix substrate for the liquid crystal equipments of the active-matrix drive method by TFT drive. Such an active-matrix substrate constitutes liquid crystal equipment by being stuck by an opposite substrate and the sealant and enclosing liquid crystal among both substrates. As for the poor active-matrix substrate from which the various wiring formed on the substrate has disconnected and connected too hastily especially here, or TFT has produced the leakage current, it is desirable from viewpoints of manufacture, such as increase in efficiency and low-cost-izing, to discover before before like the assembler who assembles the active-matrix substrate concerned to liquid-crystal equipment, the scribe process which separates mutually the active-matrix substrate concerned formed on the mother substrate, and not to carry into the following process. [two or more] Then, in addition to a scanning-line drive circuit, a data-line drive circuit, a sampling circuit, a precharge circuit, etc., the inspection circuit constituted by the execute permission in electrical property inspection of the active-matrix substrate concerned before being assembled by liquid crystal equipment may be established in this kind of active-matrix substrate as one of the circumference circuits formed in the boundary region of a screen-display field.
[0003] The checking wiring with which two or more checking terminals for inputting or measuring the inspection signal supplied to the data line through checking driving signals, these switching elements, etc. for such an inspection circuit being equipped with switching elements, such as two or more TFT connected to two or more data lines, respectively, and driving these switching elements are prepared in exclusive use on a substrate, and connect from these checking terminals to an inspection circuit further is formed in exclusive use. And applying a probe to a checking terminal and inputting the checking signal of predetermined voltage into it, for example, by inputting a checking driving signal to predetermined timing, it is constituted so that it may be the unit of each data line or electrical property inspection of the shut down inspection of two or more data lines, open-circuit inspection, leak inspection of a sampling switch, etc. can be conducted in the unit of the group of two or more data lines.
[0004] On the other hand, among above-mentioned circumference circuits, especially a precharge circuit is the timing preceded with the picture signal supplied from a data-line drive circuit to the data line for the purpose of reduction of improvement in a contrast ratio, the stability of the potential level of the data line, and the line unevenness on the display screen etc., and is a circuit which mitigates the load at the time of writing a picture signal in the data line by supplying a precharge signal. In case a picture signal will be written in the data line in 1H reversal drive method which reverses the voltage which is reversed a predetermined period, and drives for example, impresses the voltage polarity of the data line usually performed to liquid crystal for every scanning line if the precharge signal is beforehand written in the data line in order to carry out the alternating current drive especially of the liquid crystal, required quantity of electricity can be lessened notably. For example, an example of such a precharge circuit is indicated by JP,7-295520,A. Moreover, a sampling circuit is a circuit which samples a picture signal, in order to supply the picture signal of high

frequency to each data line stably to predetermined timing synchronizing with a scanning signal.
[0005] Here, if the substrate size of the liquid crystal equipment equipped with the circumference circuit on the substrate as mentioned above is the same, the screen-display field specified by two or more pixel sections arranged in the shape of a matrix, i.e., the field as which a picture is actually displayed by change of the orientation state of liquid crystal on liquid crystal equipment, is made so good that it is large as a fundamental request of display. Therefore, it is common that circumference circuits including the inspection circuit and precharge circuit which were mentioned above are established in a part for the long and slender periphery with a narrow substrate located in the circumference of a screen-display field.
[0006]
[Problem(s) to be Solved by the Invention] However, if it is going to establish both the inspection circuits and precharge circuits which were mentioned above in a part for the periphery of an active-matrix substrate, the trouble that reservation of the formation field of TFT, leading about of wiring, etc. which constitute these circuits become difficult will arise. That is, when it prepares in the part for an above-mentioned narrow long and slender periphery to a sampling circuit, a precharge circuit, an inspection circuit, etc. in addition to a scanning-line drive circuit or a data-line drive circuit, there is a trouble that it becomes difficult to design these circumference circuits so that specific specification may be met.
[0007] About the checking terminal which is needed when preparing especially an inspection circuit, the area of a terminal area becomes about 100micrometerx100micrometer from the relation of standing a probe. That is, there is a trouble that the precious field on such a substrate side will be occupied for inspection conducted before the assembly of liquid crystal equipment. In addition, since the checking terminal prepared on the substrate side in this way usually consists of metal thin films, such as aluminum (aluminum), etc. and is left behind as it is also at the time of un-using it after inspection, it also has the trouble that it corrodes after being produced commercially, and liquid crystal equipment is not worsened or the quality of a display image may be reduced.
[0008] this invention is made in view of the trouble mentioned above, and let it be a technical problem to offer the inspection method of the active-matrix substrate for liquid crystal equipments which realizes a precharge function and a checking feature using the comparatively narrow field on a substrate, the liquid crystal equipment using this, electronic equipment, and this active-matrix substrate.
[0009]
[Means for Solving the Problem] In order that an active-matrix substrate according to claim 1 may solve the above-mentioned technical problem Two or more scanning line and two or more data lines which are the active-matrix substrates for constituting the liquid crystal equipment with which it comes to pinch liquid crystal between the substrates of a couple, and carry out phase intersection on one substrate of the substrates of the aforementioned couple, The scanning-line drive circuit which supplies a scanning signal to two or more aforementioned scanning lines, and a picture signal supply means to be prepared in the end side of two or more aforementioned data lines, and to supply a picture signal to two or more aforementioned data lines, Two or more pixel sections by which an activity drive is carried out based on the aforementioned scanning signal and the aforementioned picture signal which are established in the shape of a matrix and supplied through two or more aforementioned scanning lines and two or more aforementioned data lines, respectively, It is prepared in the other end side of two or more aforementioned data lines. While supplying an inspection signal to two or more aforementioned data lines at least, respectively at the time of inspection, it is characterized by having the precharge [inspection-cum-] circuit which precedes the precharge signal of a predetermined voltage level with the aforementioned picture signal at the time of normal operation, and is supplied to two or more aforementioned data lines, respectively.
[0010] According to the active-matrix substrate according to claim 1, a picture signal supply means to supply a picture signal to two or more data lines is prepared in the end side of two or more data lines, and the precharge [inspection-cum-] circuit is established in the other end side of two or more data lines. Here, at the time of inspection, the inspection signal for performing electrical property inspection of a predetermined kind to two or more data lines at least is supplied by the precharge [inspection-cum-] circuit, respectively. Therefore, electrical property inspection of predetermined kinds, such as opening or open-circuit inspection to the pixel section connected to each data line located among both, respectively or this, and shunt evaluation, can be conducted using a precharge [inspection-cum-] circuit, and a picture signal supply means.
[0011] On the other hand, at the time of normal operation, the precharge signal of a predetermined voltage level precedes with the picture signal supplied from a picture signal supply means, and is supplied to two or more data lines by the precharge [inspection-cum-] circuit, respectively. And a picture signal is supplied to two or more data lines by the picture signal supply means. That is, supply of a picture signal to each data line which precharge about each data line was performed by the precharge [inspection-cum-] circuit, and was precharged will be performed by the picture

signal supply means good.
[0012] As mentioned above, since a precharge [inspection-cum-] circuit has a checking feature in the case of inspection carried out a front, in front of a scribe process, etc. and has a precharge function like the assembler to liquid-crystal equipment in the case of the normal operation after the assembly to liquid-crystal equipment, a substrate top field required in order to realize these two functions is notably small, and ends as compared with the case where an inspection circuit and a precharge circuit are separately established in a part for the periphery of a substrate like before.

[0013] An active-matrix substrate according to claim 2 is set to an active-matrix substrate according to claim 1. the aforementioned precharge [inspection-cum-] circuit It is constituted including two or more precharge switches which carry out the switching output of the precharge signal inputted through a precharge signal line according to a precharge circuit driving signal, respectively, and are supplied to two or more aforementioned data lines as the aforementioned inspection signal or the aforementioned precharge signal, respectively. A sampling circuit with two or more sampling switches which the aforementioned picture signal supply means samples the picture signal inputted through a picture signal line according to a sampling circuit driving signal, respectively, and are supplied to two or more aforementioned data lines as the aforementioned picture signal, respectively, It is characterized by being constituted including the data-line drive circuit which supplies the aforementioned sampling circuit driving signal to two or more aforementioned sampling switches, respectively.
[0014] According to the active-matrix substrate according to claim 2, two or more sampling switches which can be set to a sampling circuit are constituted so that the picture signal inputted through a picture signal line may be sampled according to a sampling circuit driving signal, respectively, and the data-line drive circuit is constituted so that a sampling circuit driving signal may be supplied to two or more sampling switches, respectively. Here, in a precharge circuit, according to a precharge circuit driving signal, a switching output is carried out by two or more precharge switches, and the precharge signal inputted through a precharge signal line is supplied to two or more data lines as an inspection signal, respectively at the time of inspection. Therefore, electrical property inspection of a predetermined kind to each data line located, respectively between two or more precharge switches and two or more sampling switches can be conducted using a precharge switch, a sampling switch, and a data-line drive circuit.
[0015] On the other hand, in a precharge circuit, according to a precharge circuit driving signal, a switching output is carried out by two or more precharge switches, and the precharge signal inputted through a precharge signal line is supplied to two or more data lines as a precharge signal, respectively at the time of normal operation. And in a picture signal supply means, if a sampling circuit driving signal is supplied to two or more sampling switches by the data-line drive circuit, respectively, according to a sampling circuit driving signal, the picture signal inputted through a picture signal line will be sampled by two or more sampling switches, respectively, and will be supplied to two or more data lines as a picture signal, respectively. That is, precharge about each data line will be performed by the precharge [inspection-cum-] circuit, and supply of a picture signal to each precharged data line will be performed by the picture signal supply means good.
[0016] In an active-matrix substrate according to claim 2, the aforementioned data line is connected to a source electrode, the aforementioned precharge signal line is connected to a drain electrode, and, as for an active-matrix substrate according to claim 3, the aforementioned precharge circuit driving-signal line is characterized by the bird clapper from the TFT connected to the gate electrode, respectively, as for two or more aforementioned precharge switches.
[0017] According to the active-matrix substrate according to claim 3, the TFT which makes two or more precharge switches will be in an ON state, if a precharge circuit driving signal is supplied to a gate electrode through a precharge circuit driving-signal line, and it supplies the precharge signal supplied to a drain electrode through a precharge signal line from a source electrode as a precharge signal as an inspection signal to the data line at the time of normal operation at the time of inspection, respectively.
[0018] Therefore, at the time of inspection, electrical property inspection of a predetermined kind to each data line located between such TFT and two or more sampling switches, respectively can be conducted using the switching operation of such TFT. Moreover, using the switching operation of such TFT, precharge about each data line will be performed and supply of a picture signal to each precharged data line will be performed by the picture signal supply means good at the time of normal operation.
[0019] In an active-matrix substrate according to claim 3, as for an active-matrix substrate according to claim 4, the aforementioned TFT is characterized by the bird clapper from one of an N channel type transistor, a P channel type transistor, and complementary transistors.
[0020] According to the active-matrix substrate according to claim 4, using TFT of an N channel type transistor and a P channel type transistor, i.e., a piece channel, and the switching operation of the precharge switch which consists of a

complementary transistor constituted from an N channel type transistor and a P channel type transistor, electrical property inspection of a predetermined kind can be ensured at the time of inspection, and precharge can be ensured at the time of normal operation.

[0021] An active-matrix substrate according to claim 5 is set to an active-matrix substrate given in any 1 term of claims 2-4. the aforementioned data-line drive circuit The shift register of one sequence which outputs a transfer signal one by one from each stage, After restricting the time length of the aforementioned transfer signal so that the aforementioned transfer signal outputted almost simultaneously from two stages in this shift register which adjoin each other may not lap mutually in time, it is characterized by having the wave control circuit outputted as the aforementioned sampling circuit driving signal.

[0022] According to the active-matrix substrate according to claim 5, if a transfer signal is outputted one by one from each stage of the shift register of one sequence, after the time length of a transfer signal is restricted by the wave control circuit, it will be outputted by it as a sampling circuit driving signal, so that the transfer signal outputted almost simultaneously from this shift register may not lap mutually in time. Therefore, it originates in operation of the sampling switch corresponding to the time lap in the transfer signal which gets mixed up, and the situation where a picture signal, an inspection signal, and a precharge signal will be supplied ranging over two or more data lines can be prevented. and if a precharge signal is made into two sequences even when it can be managed with one sequence and will perform the above-mentioned 1H reversal drive, if the precharge signal and precharge circuit driving signal which will be supplied to a precharge [inspection-cum-] circuit if constituted in this way are the case where 1H reversal drive like the above-mentioned is not performed, respectively, it is sufficient for them with one sequence a precharge circuit driving signal -- Therefore, as compared with the case where a sampling switch is driven by the data-line drive circuit based on the transfer signal of two or more sequences outputted from the shift register of two or more sequences, the I/O wiring for a precharge signal or precharge circuit driving signals concerning a precharge [inspection-cum-] circuit and the number of input/output terminals can be reduced sharply.

[0023] It is characterized by constituting the active-matrix substrate according to claim 6 including the TFT for an active drive in respectively two or more aforementioned pixel sections in the active-matrix substrate given in any 1 term of claims 1-5, and the aforementioned precharge [inspection-cum-] circuit consisting of same films as the TFT of the aforementioned pixel section including the TFT formed simultaneously.

[0024] Since it is simultaneously formed from the film with same TFT in the pixel section and TFT in a precharge [inspection-cum-] circuit according to the active-matrix substrate according to claim 6, manufacture of such TFT is comparatively easy and can attain low-cost-ization of the whole equipment.

[0025] Liquid crystal equipment according to claim 7 is characterized by equipping any 1 term of claims 1-6 with the active-matrix substrate of a publication, the substrate of another side of the substrates of the aforementioned couple, and the aforementioned liquid crystal.

[0026] According to liquid crystal equipment according to claim 7, it has the active-matrix substrate of this invention mentioned above, and is constituted, and since various kinds of pre- electrical property inspection is ensured, it is as reliable as an assembler. Moreover, since neither the I/O wiring only for an inspection circuit or inspection circuits nor an input/output terminal exists, the circumference circuit for performing normal operation, such as a precharge circuit, a sampling circuit, a data-line drive circuit, and a scanning-line drive circuit, can form with a margin.

[0027] Liquid crystal equipment according to claim 8 is set to liquid crystal equipment according to claim 7. The seal member which sticks the substrate of the aforementioned couple in the circumference of the screen-display field specified by two or more aforementioned pixel sections, and surrounds the aforementioned liquid crystal, It has further circumference abandonment of the shading nature formed along with the profile of the aforementioned screen-display field at the substrate of aforementioned another side between the aforementioned seal member and the aforementioned screen-display field. At least one side of the I/O wiring of the aforementioned precharge [inspection-cum-] circuit and the aforementioned precharge [inspection-cum-] circuit is characterized by being prepared in the position which counters the aforementioned circumference abandonment.

[0028] According to liquid crystal equipment according to claim 8, circumference abandonment of shading nature is formed along with the profile of a screen-display field at the 2nd substrate between the seal member and the screen-display field on the substrate (namely, opposite substrate) of another side. And either [at least] a precharge [inspection-cum-] circuit or its I/O wiring is formed in one substrate in the position (henceforth "the bottom of circumference abandonment") which counters circumference abandonment. Here, a precharge [inspection-cum-] circuit is a circuit of an alternating current drive fundamentally at the time of normal operation. For this reason, while faces the liquid crystal which was surrounded by the seal member and pinched among both substrates, and even if it forms a precharge [inspection-cum-] circuit, and its I/O wiring in a substrate portion, the problem of degradation of the liquid crystal by direct-current-voltage impression is not produced. And in this way, by forming a precharge

[' inspection-cum-] circuit, and its I/O wiring in the bottom of circumference abandonment, it can have a margin in a part for the periphery of a narrow long and slender substrate, and for example, a scanning-line drive circuit and a data-line drive circuit can be formed in it.

[0029] Electronic equipment according to claim 9 is characterized by having liquid crystal equipment according to claim 8.

[0030] Since according to electronic equipment according to claim 9 it has liquid crystal equipment of this invention mentioned above and is constituted, the miniaturization is attained, high-definition operation is possible, and, moreover, it is reliable.

[0031] The inspection method of an active-matrix substrate according to claim 10 Making two or more aforementioned precharge switches of all into an ON state, while being the inspection method of inspecting the active-matrix substrate of a publication and carrying out normal operation of the (i) aforementioned data-line drive circuit to claims 2-6 measuring the current which impresses predetermined voltage to the aforementioned precharge signal line, and flows on the aforementioned picture signal line -- or (ii) Making into an ON state two or more precharge switches of all simultaneously driven by the aforementioned precharge circuit driving signal, while carrying out normal operation of the aforementioned data-line drive circuit By measuring the current which impresses predetermined voltage to the aforementioned picture signal line, and flows to the aforementioned precharge signal line, it is characterized by conducting opening or open-circuit inspection of two or more aforementioned data lines.

[0032] Predetermined voltage is impressed to a precharge signal line, making two or more precharge switches of all into an ON state according to the inspection method of an active-matrix substrate according to claim 10, while carrying out normal operation of the (i) data-line drive circuit. Then, the predetermined voltage impressed to the precharge signal line is impressed to each data line through the precharge switch made into the ON state. And since it was turned on in the group unit which a sampling switch becomes from a data-line unit or two or more data lines, when each data line and each picture signal line are made into switch-on, current flows on a picture signal line. Then, the current which flows on this picture signal line is measured, and if it compares with the reference current obtained when the pixel section connected to the data line or this is in a normal state, opening or an open circuit of the data line can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[0033] Or predetermined voltage is impressed to a picture signal line, making into an ON state two or more precharge switches of all simultaneously driven by the precharge circuit driving signal, while carrying out normal operation of the (ii) data-line drive circuit. Then, the predetermined voltage impressed to the picture signal line is sampled by the sampling switch, and is impressed to each data line. And since the precharge switch is turned on and each data line and the precharge signal line are made into switch-on, current flows to a precharge signal line with the voltage impressed to each data line. Then, if it compares with the reference current obtained when the current which flows to this precharge signal line is measured and the data line etc. is in a normal state, opening or an open circuit of the data line can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[0034] The inspection method of an active-matrix substrate according to claim 11 Making two or more aforementioned precharge switches of all into an OFF state, while being the inspection method of inspecting the active-matrix substrate of a publication to claims 2-6 and making all the (i) aforementioned sampling switches into an ON state measuring the current which flows between the picture signal lines by which electrical installation is carried out to the data line which impresses predetermined voltage and this adjoins each other between the picture signal lines by which electrical installation is carried out to the data line which adjoins each other -- or (ii) Making two or more aforementioned precharge switches of all into an ON state, while making all the aforementioned sampling switches into an OFF state By measuring the current which flows between the precharge signal lines by which electrical installation is carried out to the data line which impresses predetermined voltage and this adjoins each other between the precharge signal lines by which electrical installation is carried out to the data line which adjoins each other, it is characterized by conducting shunt evaluation of two or more aforementioned data lines.

[0035] Predetermined voltage is impressed between the picture signal lines by which electrical installation is carried out to the data line which adjoins each other, making two or more precharge switches of all into an OFF state according to the inspection method of an active-matrix substrate according to claim 11, while making all the (i) sampling switches into an ON state. Then, although predetermined voltage is impressed to the data line from a picture signal line through a sampling switch, since all precharge switches are turned off, the data line which adjoins each other is insulated mostly mutually, and current should not flow between picture signal lines. Then, if it compares with the reference current obtained when the current which flows between the picture signal lines by which electrical installation is carried out to the data line which adjoins each other is measured and the data line etc. is in a normal state in this state (close to about 0), the short circuit of the data line can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[0036] Or predetermined voltage is impressed between the precharge signal lines by which electrical installation is carried out to the data line which adjoins each other, making two or more precharge switches of all into an ON state, while making all the (ii) sampling switches into an OFF state. Then, although predetermined voltage is impressed to the data line from a precharge signal line through a precharge switch, since all sampling switches are turned off, the data line which adjoins each other is insulated mostly mutually, and current should not flow between precharge signal lines. Then, if it compares with the reference current obtained when the current which flows between the precharge signal lines by which electrical installation is carried out to the data line which adjoins each other is measured and the data line is in a normal state in this state (close to about 0), the short circuit of the data line can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[0037] The inspection method of an active-matrix substrate according to claim 12 Making two or more aforementioned precharge switches of all into an ON state, while being the inspection method of inspecting the active-matrix substrate of a publication to claims 2-6 and making all the (i) aforementioned sampling switches into an OFF state measuring the current which impresses predetermined voltage to the aforementioned precharge signal line, and flows on the aforementioned picture signal line -- or (ii) Making into an ON state two or more precharge switches of all simultaneously driven by the aforementioned precharge circuit driving signal, while making all the aforementioned sampling switches into an OFF state By measuring the current which impresses predetermined voltage to the aforementioned picture signal line, and flows to the aforementioned precharge signal line, it is characterized by conducting leak inspection of the aforementioned sampling switch.

[0038] Predetermined voltage is impressed to a precharge signal line, making two or more precharge switches of all into an ON state according to the inspection method of an active-matrix substrate according to claim 12, while making all the (i) sampling switches into an OFF state. Then, although predetermined voltage is impressed to the data line from a precharge signal line through a precharge switch, since all sampling switches are turned off, current should not flow on a picture signal line from the data line with the predetermined voltage of the data line. Then, if it compares with the reference current obtained when the current which flows on a picture signal line is measured and a sampling switch is in a normal state in this state (close to about 0), leak of a sampling switch can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[0039] Or predetermined voltage is impressed to a picture signal line, making into an ON state two or more precharge switches of all simultaneously driven by the precharge circuit driving signal, while making all the (ii) sampling switches into an OFF state. Then, since all sampling switches are turned off, current should not flow to a precharge signal line through the data line and the precharge switch with the predetermined voltage of a picture signal line. Then, if it compares with the reference current obtained when the current which flows to a precharge signal line is measured and a sampling switch is in a normal state in this state (close to about 0), leak of a sampling switch can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[0040] The inspection method of an active-matrix substrate according to claim 13 Making two or more aforementioned precharge switches of all into an OFF state, while being the inspection method of inspecting the active-matrix substrate of a publication to claims 2-6 and making all the (i) aforementioned sampling switches into an ON state measuring the current which impresses predetermined voltage to the aforementioned precharge signal line, and flows on the aforementioned picture signal line -- or (ii) by measuring the current which impresses predetermined voltage to the aforementioned picture signal line, and flows to the aforementioned precharge signal line, making two or more aforementioned precharge switches of all into an OFF state, while making all the aforementioned sampling switches into an ON state It is characterized by conducting leak inspection of the aforementioned precharge switch.

[0041] Predetermined voltage is impressed to a precharge signal line, making two or more precharge switches of all into an OFF state according to the inspection method of an active-matrix substrate according to claim 13, while making all the (i) sampling switches into an ON state. Then, since all precharge switches are turned off, current should not flow on a picture signal line through the data line and the sampling switch with the predetermined voltage of a precharge signal line. Then, if it compares with the reference current obtained when the current which flows on a picture signal line is measured and a precharge switch is in a normal state in this state (close to about 0), leak of a precharge switch can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[0042] Or predetermined voltage is impressed to a picture signal line, making two or more precharge switches of all into an OFF state, while making all the (ii) sampling switches into an ON state. Then, although predetermined voltage is impressed to the data line from a picture signal line through a sampling switch, since all precharge switches are turned off, current should not flow from the data line to a precharge signal line with the predetermined voltage of the data line. Then, if it compares with the reference current obtained when the current which flows to a precharge signal line is measured and a precharge switch is in a normal state in this state (close to about 0), leak of a precharge switch can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[0043] Such an operation and other gains of this invention are made clear from the form of the operation explained below.
[0044]
[Embodiments of the Invention] Hereafter, the form of operation of this invention is explained based on a drawing.
[0045] (Composition of an active-matrix substrate) The composition of the form of operation of the active-matrix substrate of this invention is explained based on drawing 3 from drawing 1 .
[0046] First, the circuitry of the whole active-matrix substrate is explained with reference to drawing 1 . Drawing 1 is representative circuit schematics, such as various wiring, a circumference circuit, etc. which were established in the active-matrix substrate.
[0047] The active-matrix substrate is equipped with the TFT array substrate 1 which consists of a quartz substrate, hard glass, a silicon substrate, etc. in drawing 1 . Two or more pixel electrodes 11 prepared in the shape of a matrix on the TFT array substrate 1, The data line 35 which are arranged in the direction of X, and is extended along the direction of Y, respectively, [two or more] The scanning line 31 which are arranged in the direction of Y, and is extended along the direction of X, respectively, [two or more] While intervening between each data line 35 and the pixel electrode 11, respectively, two or more TFT30 as an example of the switching element which controls the switch-on and the non-switch-on between these according to the scanning signals Y1, Y2, --, Ym supplied through the scanning line 31, respectively, respectively is formed. Moreover, on the TFT array substrate 1, capacity line 31' which is wiring for a storage capacitance 70 is mostly formed along with the scanning line 31 at parallel, and a storage capacitance 70 is added to the pixel electrode 11. Thereby, a parasitic capacitance can prevent degradation of display grace, such as a flicker produced owing to. In addition, you may use the scanning line 31 of the preceding paragraph for forming a storage capacitance 70 as an electrode for storage-capacitance formation. If such composition is taken, since it is not necessary to prepare capacity line 31', a pixel numerical aperture can be raised and bright liquid crystal equipment can be offered. By the way, the picture signals S1, S2, --, Sn written in the data line 35 may be supplied to line sequential, and you may make it supply them to this order for every group to two or more data-line 35 comrades which adjoin each other. Thus, two or more data lines 35 which adjoin each other are driven simultaneously, by shifting the phase of a picture signal, it becomes possible to reduce the drive frequency of a data-line drive circuit, and circuit reliability and low-power-ization can be realized.
[0048] At the time of the inspection in the preceding paragraph story further assembled by liquid crystal equipment 200 (it mentions later) on the TFT array substrate 1 The checking feature which conducts various kinds of electric inspection, such as opening of the TFT30 grade of the pixel section connected to the data line 35 or this or open-circuit inspection, and shunt evaluation The precharge signal NRS of a predetermined voltage level to two or more data lines 35 at the time of the normal operation of liquid crystal equipment 200 Picture signals S1 and S2, --, The precharge [inspection-cum-] circuit 201 equipped with both functions with the precharge function which precedes with Sn and is supplied, respectively, The sampling circuit 301 which samples picture signals S1, S2, --, Sn, and is supplied to two or more data lines 35, respectively, the data-line drive circuit 101, and the scanning-line drive circuit 104 are formed.
[0049] The scanning-line drive circuit 104 impresses the scanning signals Y1, Y2, --, Ym to the scanning line 31 (gate electrode line) by line sequential in pulse to predetermined timing based on the power supply supplied from an external-control circuit, a reference clock CLY, its reversal clock, etc.
[0050] According to the timing to which the scanning-line drive circuit 104 impresses the scanning signals Y1, Y2, --, Ym based on the power supply and reference clock CLX to which the data-line drive circuit 101 is supplied from an external-control circuit, its reversal clock, etc., about picture signal line 304 each, the sampling circuit driving signals SH1, SH2, --, SHn are minded every data line 35, the sampling circuit driving-signal line 306 is minded [301], and it supplies to predetermined timing.
[0051] As a switching element, it has TFT202 every data line 35, the precharge signal line 204 is connected to the drain or source electrode of TFT202, and, as for the precharge [inspection-cum-] circuit 201, the precharge circuit driving-signal line 206 is connected to the gate electrode of TFT202. And the power supply of predetermined voltage required at the time of normal operation, in order to write in the precharge signal NRS from an external power through the precharge signal line 204 is supplied, and the precharge circuit driving signal NRG is supplied from an external-control circuit so that the precharge signal NRS may be written in through the precharge circuit driving-signal line 206 to the timing preceded with picture signals S1, S2, --, Sn about each data line 35. The precharge [inspection-cum-] circuit 201 supplies the precharge signal NRS (picture auxiliary signal) which is preferably equivalent to the picture signals S1, S2, --, Sn of middle gradation level. Moreover, at the time of inspection, that electric inspection of a predetermined kind should be carried out like the after-mentioned, checking voltage is impressed to the data line 35, or the precharge [inspection-cum-] circuit 201 is constituted so that it may be possible to pass checking current.
[0052] The sampling circuit 301 is equipped with TFT302 every data line 35, the picture signal line 304 is connected to

the source electrode of TFT302, and the sampling circuit driving-signal line 306 is connected to the gate electrode of TFT302. And these will be sampled if picture signals S1, S2, --, Sn are inputted through the picture signal line 304. That is, if the sampling circuit driving signals SH1, SH2, --, SHn are inputted from the data-line drive circuit 101 through the sampling circuit driving-signal line 306, picture signals S1, S2, --, Sn will be impressed to the data line 35 one by one about picture signal line 304 each.

[0053] Thus, although it consists of gestalten of this operation so that the data line 35 may be chosen for [every], you may constitute so that simultaneous selection of the data line 35 may be carried out collectively two or more [every]. For example, according to the write-in property of TFT302 which constitutes a sampling circuit 301, and the frequency of a picture signal, the picture signals S1, S2, --, Sn by which phase expansion was carried out may be supplied to two or more phases (for example, a three phase circuit, six phases, 12 phases, --) from the picture signal line 304, and you may constitute so that these may be simultaneously sampled for every group. Under the present circumstances, only the number of phase expansions cannot be overemphasized by that the picture signal line 304 is required at least.

[0054] Next, the concrete circuitry of TFT 202 and 302 which constitutes the precharge [inspection-cum-] circuit 201 and a sampling circuit 301 is explained with reference to drawing 2 and drawing 3 , respectively. In addition, drawing 2 is the circuit diagram showing various kinds of TFT which constitutes TFT202 of the precharge [inspection-cum-] circuit 201, and drawing 3 is the circuit diagram showing various kinds of TFT which constitutes TFT302 of a sampling circuit 301.

[0055] As shown in drawing 2 (1), TFT202 (refer to drawing 1) of the precharge circuit 201 may consist of N channel type TFT202a, as shown in drawing 2 (2), may consist of P channel type TFT202b, and may consist of complementary-type TFT202c which consists of N channel type TFT and P channel type TFT as shown in drawing 2 (3). In addition, the precharge circuit driving signals 206a and 206b inputted in drawing 2 (3) through the precharge circuit driving-signal line 206 shown in drawing 1 from drawing 2 (1) are inputted into each TFT 202a-202c as a gate voltage. The precharge signal NRS inputted through the precharge signal line 204 similarly shown in drawing 1 is inputted into each TFT 202a-202c as source voltage. Precharge circuit driving-signal 206a impressed to N channel type TFT202a as a gate voltage and precharge circuit driving-signal 206b impressed to P channel type TFT202b as a gate voltage are reversal signals mutual. Therefore, in constituting the precharge circuit 201 from complementary-type TFT202c, at least two or more precharge circuit driving-signal lines 206 are needed. Thus, when the precharge circuit driving-signal line 206 becomes two or more, one screen-display field side may be wired intensively, and you may wire from the both sides of a screen-display field combining the precharge signal line 204. or -- for example, precharge circuit driving-signal 206a may be reversed by the inverter before [that each or plurality adjoins each other] complementary-type TFT202c, and precharge circuit driving-signal 206b may be formed

[0056] As shown in drawing 3 (1), TFT302 (refer to drawing 1) of a sampling circuit 301 may consist of N channel type TFT302a, as shown in drawing 3 (2), it may consist of P channel type TFT302b, and as shown in drawing 3 (3), it may consist of complementary-type TFT302c. In addition, the picture signal VID inputted through the picture signal line 304 shown in drawing 1 in drawing 3 (3) from drawing 3 (1) is inputted into each TFT 302a-302c as source voltage. The sampling circuit driving signals 306a and 306b inputted through the sampling circuit driving-signal line 306 from the data-line drive circuit 101 similarly shown in drawing 1 are inputted into each TFT 302a-302c as a gate voltage. Moreover, also in a sampling circuit 301, sampling circuit driving-signal 306a impressed to N channel type TFT302a as a gate voltage and sampling circuit driving-signal 306b impressed to P channel type TFT302b as a gate voltage are reversal signals like the case of the above-mentioned precharge circuit 201 mutual. Therefore, in constituting a sampling circuit 301 from complementary-type TFT302c, sampling circuit driving-signal 306a and at least two or more sampling circuit driving-signal lines 306 for 306b are needed.

[0057] Next, it explains still in detail about the composition and operation of the precharge [inspection-cum-] circuit 201 with which liquid crystal equipment 200 was equipped.

[0058] (Precharge function of a precharge [inspection-cum-] circuit) First, drawing 4 is referred to and the precharge function by the precharge [inspection-cum-] circuit 201 at the time of the normal operation of liquid crystal equipment 200 is explained. In addition, drawing 4 is the timing chart of the various signals at the time of the normal operation of a precharge [inspection-cum-] circuit.

[0059] Although the clock signal (CLX) which specifies the selection time t1 (dot frequency) per pixel is inputted into the shift register which the data-line drive circuit 101 has as criteria of a horizontal scanning as shown in drawing 4 , if a transfer start signal (DX) is inputted, the transfer signals X1 and X2 and -- will be supplied one by one from this shift register. In each horizontal scanning period, a precharge circuit driving signal (NRG) is supplied to the timing preceded with the input of such a transfer start signal (DX). While the clock signal (CLY) made into the criteria of a vertical scanning becomes more specifically high-level, after a picture signal (VID) inverts on the basis of the voltage central value (VID center) of a signal, a precharge circuit driving signal (NRG) is made high-level after time [to be a margin

until it carries out precharge from this inversion] t3 progress. On the other hand, let a precharge signal (NRS) be the predetermined level of a picture signal (VID) and like-pole nature in a horizontal-retrace-line period corresponding to reversal of a picture signal (VID). Therefore, precharge is performed in the time t2 when a precharge circuit driving signal (NRG) is made high-level. And let a precharge circuit driving signal (NRG) be a low level by making a margin after before, i.e., precharge, ends only time t4 rather than the time of a horizontal-retrace-line period expiring and an effective display period starting until a picture signal is written in into time t4. As mentioned above, in each horizontal-retrace-line period, the precharge [inspection-cum-] circuit 201 precedes a precharge signal (NRS) with a picture signal, and supplies it to two or more data lines 35.

[0060] (Checking feature of a precharge [inspection-cum-] circuit) Next, with reference to drawing 8 , the checking feature of the precharge [inspection-cum-] circuit 201 is explained from drawing 5 . In addition, drawing 5 (a) is the circuit diagram of the example of 1 composition of the data-line drive circuit 101 in the state where the shut down inspection of the data line is conducted, and the precharge [inspection-cum-] circuit 201, and drawing 5 (b) is the timing chart. Drawing 6 is the circuit diagram of the example of 1 composition of the data-line drive circuit 101 in the state where shunt evaluation of the data line is conducted, and the precharge [inspection-cum-] circuit 201. Drawing 7 is other examples of composition of the data-line drive circuit 101, and the circuit diagram of the precharge [inspection-cum-] circuit 201. drawing 8 (a) -- being concerned -- others -- it is the circuit diagram of 1 sequence portion of the shift register with which the example of composition was equipped, and drawing 8 (b) is the timing chart

[0061] Especially with the gestalt of this operation, as shown in drawing 1 , the data-line drive circuit 101 and the sampling circuit 301 are formed in the end side of two or more data lines 35, and the precharge [inspection-cum-] circuit 201 is established in the other end side of two or more data lines. Moreover, by drawing 7 , the pixel field located in the center of the data line is omitted from drawing 5 , and the circuitry by the side of the end of the data line and the circuitry by the side of the other end are shown. And at the time of inspection, TFT202 contained in the precharge [inspection-cum-] circuit 201 will be in an ON state, respectively, if a precharge circuit driving signal (NRG) is supplied to a gate electrode through the precharge circuit driving-signal line 206, and the precharge signal (NRS) supplied to a drain electrode through the precharge signal line 204 is supplied from a source electrode as an inspection signal to the data line 35 at the time of inspection. Or the current which flows through the precharge signal line 204 is measured as inspection current.

[0062] Therefore, it can carry out so that the electrical property inspection of a predetermined kind to TFT of the pixel section connected to each data line 35 located among such TFT202 and TFT302 of a sampling circuit 301, respectively or this etc. may be explained below using the switching operation of TFT202 of the precharge [inspection-cum-] circuit 201.

[0063] In addition, although the form of this operation explains the case where the picture signal line 304 is formed in 6 parallel corresponding to the picture signals VID1-VID6 by which 6 phase expansion was carried out, neither the number of phase expansions nor the number of the picture signal line 304 is restricted to this.

[0064] (1) As shown in drawing 5 and drawing 6 , the 1st inspection method point ** and the data-line drive circuit 101 The shift register 303 of one sequence which outputs a transfer signal one by one from each stage, After restricting the time length of a transfer signal so that the transfer signal outputted almost simultaneously from two stages in a shift register 303 which adjoin each other may not lap mutually in time The case where it has the wave control circuit 307 outputted as a sampling circuit driving signal Qn (n= 1, 3 [2 and 3], --) is explained.

[0065] In this case, to the timing shown in drawing 5 (b), a shift register 303 will output a transfer signal one by one synchronizing with a clock signal CLX and its reversal signal, if start signal DX is inputted. In drawing 5 (a) and in the wave control circuit 307 The non-AND of an enable signal ENB1 and the transfer signal outputted from odd level is taken by the NAND circuit, and a wave is orthopedically operated further by the buffer circuit 308. on the other hand The non-AND of an enable signal ENB2 and the transfer signal outputted from even level is taken by the NAND circuit, a wave is orthopedically operated further by the buffer circuit 308, and the sampling circuit driving signal Qn (n= 1, 3 [2 and 3], --) which does not lap mutually in time is outputted one by one. Thus, if the data-line drive circuit 101 is constituted, the situation where a picture signal and an inspection signal, and a precharge signal (NRS) will be supplied ranging over two or more data lines 35 corresponding to the time lap in the transfer signal which gets mixed up can be prevented. And if the precharge signal (NRS) and precharge circuit driving signal (NRG) which will be supplied to the precharge [inspection-cum-] circuit 201 if constituted in this way are the case where 1H reversal drive like the above-mentioned is not performed, respectively, one sequence is sufficient for them. moreover, if a precharge signal (NRS) is made into two sequences even when performing the above-mentioned 1H reversal drive, it is sufficient with one sequence a precharge circuit driving signal (NRG) -- Therefore, as compared with the case (refer to drawing 7) where a sampling circuit is driven by the data-line drive circuit based on the transfer signal of two or more

sequences outputted from the shift register of two or more sequences mentioned later, the I/O wiring for a precharge signal or precharge circuit driving signals concerning the precharge [inspection-cum-] circuit 201 and the number of input/output terminals can be reduced sharply. In addition, as shown in drawing 2 (3), when it constitutes TFT202 from a complementary type TFT, it is necessary to input the precharge circuit driving signal NRG and its reversal signal into the two gates of each TFT202. In this case, the precharge circuit driving signal NRG and its reversal signal may be supplied through two precharge circuit driving-signal lines 206, and are the interior of liquid crystal equipment 200, and you may make it generate a reversal signal from the precharge circuit driving signal NRG.

[0066] With the gestalt of this operation, since the shift register 303 and the wave control circuit 307 of one sequence are used, in order to conduct inspection which measures the current in the picture signal line 304, and is explained below every data line 35 (that is, a fault is discovered in the unit of the data line), the number of sequences of a precharge circuit driving signal (NRG) or a precharge signal (NRS) is set up so that the following formula may be filled.

[0067] "The number of the data lines turned on in number of sequences x **** of a number of picture signal sequences >= shift register"

Or if it inspects for every data line by the amperometry in the precharge signal line 204 like the 2nd below-mentioned inspection method, the number of sequences of a precharge circuit driving signal (NRG) or a precharge signal (NRS) will be set up instead of the amperometry in the picture signal line 304 so that the following formula may be filled.

[0068] "The number of the data lines turned on in number of sequences x **** of the number of sequences >= shift register of the number of sequences x precharge circuit driving signal of a precharge signal"

In addition, even when not filling these formulas, inspection (discovery of a fault) in the group unit which consists of two or more data lines is possible, and the purpose which discovers a defective in a production line simply and is not turned to the following processes, such as an erector degree, is attained. However, since analysis of a fault is very useful to an improvement of the rate of a defective in a subsequent manufacturing technology, it is very important for discovering a fault in the unit of the data line like the form of this operation.

[0069] (1-1) As shown in opening or open-circuit inspection, in this case drawing 5 (a) of the data line, carry out normal operation of the data-line drive circuit 101 and the scanning-line drive circuit 104. and two or more TFT202 which can be set in the precharge circuit 202 -- the precharge signal (NRS) which has predetermined voltage called 5V in the precharge signal line 204 is impressed, making a precharge circuit driving signal (NRG) high-level, making all into an ON state namely, -- Then, the predetermined voltage impressed to the precharge signal line 204 is impressed to each data line 35 through TFT202 made into the ON state. And when two or more TFT301 which can be set to a sampling circuit 301 with the voltage impressed to each data line 35 is turned on one by one by the sampling circuit driving signal Sn (n= 1, 2, --) and each data line 35 and each picture signal line 304 are made into switch-on, current flows on the picture signal line 304. Then, the current which flows on this picture signal line 304 is measured, and it compares with the reference current I obtained when the TFT30 grade of the pixel section connected to the data line 35 or this is in a normal state. And if measurement current is contained in the range of reference current I**epsilon (epsilon : permission or error range), to each data line 35, it can judge with there not being opening or an open circuit. Conversely, if it does not go into this range, to each data line 35, it can judge with there being opening or an open circuit.

[0070] In addition, in this example, since the total of the picture signal line 304 is even, if the voltage from which level differs by turns in order like H (high-level), L (low level), H, L, H, and L is impressed to these, it is 1 time and can inspect. If L, L, H, L, L, H, L, L, H, and the voltage from which level differs like -- are impressed once again after impressing to these H, H, L, H, H, L, H, H, L, and the voltage from which level differs like -- once temporarily, if the total of the picture signal line 304 is odd, inspection of this content will be attained by total of two voltage impression.

[0071] (1-2) the shunt evaluation of the data line -- in this case, stop operation of the scanning-line drive circuit 104 first and it is shown in drawing 6 -- as -- TFT302 of a sampling circuit 301 -- all -- an ON state -- carrying out (that is, start signal DX of a shift register 303 being made high-level) -- TFT202 of the precharge circuit 201 -- predetermined voltage is impressed between the picture signal lines 304 which adjoin each other, making a precharge circuit driving signal (NRG) into a low level namely,, making all into an OFF state Specifically, while impressing the high-level voltage of 15V, the low-level voltage of 0V is impressed to the picture signal line 304 corresponding to a picture signal 1, 3, and VID 5 at the picture signal line 304 corresponding to a picture signal 2, 4, and VID 6. Then, although predetermined voltage is impressed to the data line 35 from the picture signal line 304 through TFT302, since TFT202 is turned off altogether, the data line 35 which adjoins each other is insulated mostly mutually, and current should not flow among these picture signal lines 304 that adjoin each other. Then, it compares with the reference current**i obtained when the current which flows between the picture signal lines 304 which adjoin each other is measured and data-line 35 grade is in a normal state in this state (close to about 0). And if measurement current is contained in the

range of reference current**i, to each data line 35, it can judge with there being no short circuit. Conversely, if it does not go into this range, to each data line 35, it can judge with there being a short circuit.
[0072] (1-3) leak inspection of TFT of a sampling circuit -- in this case, stop operation of the scanning-line drive circuit 104 first and drawing 6 -- setting -- TFT302 of a sampling circuit 301 -- all -- an OFF state -- carrying out (that is, letting start signal DX of a shift register 303 be a low level) -- TFT202 of the precharge circuit 201 -- predetermined voltage called 12V is impressed to the precharge signal line 204, making a precharge circuit driving signal (NRG) high-level, making all into an ON state namely, -- Then, although predetermined voltage is impressed to the data line 35 from the precharge signal line 204 through TFT202, since all of TFT302 switch of a sampling circuit 301 are turned off, current should not flow on the picture signal line 304 from the data line 35 with the predetermined voltage of the data line 35. Then, it compares with the reference current**i obtained when the current which flows on the picture signal line 304 is measured and the TFT302 grade of a sampling circuit 301 is in a normal state in this state (close to about 0). And if measurement current is contained in the range of reference current**i, to each TFT302, it can judge with there being no leak. Conversely, if it does not go into this range, to each TFT302, it can judge with there being leak.
[0073] (1-4) leak inspection of TFT of a precharge circuit -- in this case, stop operation of the scanning-line drive circuit 104 first and drawing 6 -- setting -- TFT302 of a sampling circuit 301 -- all -- an ON state -- carrying out (that is, start signal DX of a shift register being made high-level) -- TFT202 of the precharge circuit 201 -- predetermined voltage called 12V is impressed to the precharge signal line 204, making a precharge circuit driving signal (NRG) into a low level, making all into an OFF state namely, -- Then, since TFT202 is turned off altogether, current should not flow on the picture signal line 304 through TFT302 of the data line 35 and a sampling circuit 301 with the predetermined voltage of the precharge signal line 204. Then, it compares with the reference current**i obtained when the current which flows on the picture signal line 304 is measured and the TFT202 grade of the precharge circuit 201 is in a normal state in this state (close to about 0). And if measurement current is contained in the range of reference current**i, to each TFT202, it can judge with there being no leak. Conversely, if it does not go into this range, to each TFT202, it can judge with there being leak.
[0074] (2) Explain the inspection method when the 2nd inspection method, next the data-line drive circuit 101 are equipped with shift register 303' of 4 sequence 8 phase which outputs a transfer signal one by one from each stage as shown in drawing 7 for example, (namely, when it does not have the wave control circuit 307 as shown in drawing 5 and drawing 6).
[0075] In drawing 7 , each sequence of shift register 303' will output a transfer signal (namely, the sampling circuit driving signals Q1 and Q2, --) one by one synchronizing with a clock signal CLX1 and its reversal signal, a clock signal CLX2 and its reversal signal, a clock signal CLX3 and its reversal signal, a clock signal CLX4, and its reversal signal, respectively, if start signal DX is inputted.
[0076] In this case, the circuit portion which constitutes one sequence (the sampling circuit driving signals Q1 and Q5, sequence which outputs Q9 --) of the shift register which can be set is extracted, it is shown in drawing 8 (a), and the timing chart is shown in drawing 8 (b). As shown in drawing 8 (b), the transfer signal (namely, the sampling circuit driving signals Q1, Q5, and Q9, --) outputted almost simultaneously from two stages which adjoin each other in each sequence of shift register 303' laps mutually in time. Moreover, the transfer signal (namely, the sampling circuit driving signals Q2, Q6, and Q10, --) similarly outputted almost simultaneously about other sequences from two stages which adjoin each other Lapping mutually in time, a transfer signal (namely, the sampling circuit driving signals Q3, Q7, and Q11, --) laps mutually in time, and a transfer signal (namely, the sampling circuit driving signals Q2, Q6, and Q10, --) laps mutually in time.
[0077] Therefore, when the data-line drive circuit 101 is constituted in this way, the composition which does not drive simultaneously TFT302 of the sampling circuit 301 connected to the same picture signal line 304 by the sampling circuit driving signal Qi which laps mutually as shown in drawing 8 (b) is taken by restricting the number of the data lines 35 simultaneously turned on using the picture signal line 304 by which 6 phase expansion was carried out.
[0078] By the 2nd inspection method, since shift register 303' of two or more sequences is used, in order to conduct inspection which measures the current in the precharge signal line 204, and is explained below every data line 35 (that is, a fault is discovered in the unit of the data line), the number of sequences of a precharge circuit driving signal (NRG) or a precharge signal (NRS) is set up so that the following formula may be filled.
[0079] "-- number of sequences x(number [of a precharge circuit driving signal] of sequences x 2) >=(number [of a shift register] of sequences x 2) x [ ] of a precharge signal -- number of the data lines" turned on simultaneously Therefore, in the example of composition shown in drawing 7 , a precharge circuit driving signal (NRG) is made into two sequences (NRG1 and NRG2), and a precharge signal (NRS) is made into four sequences (NRS1, NRS2, NRS3, and NRS4).

[0080] In addition, even when not filling the above-mentioned formula, also by measuring the current in the picture signal line 304 like the 1st inspection method mentioned above, inspection (discovery of a fault) in the group unit which consists of two or more data lines is possible, and the purpose which discovers a defective in a production line simply and is not turned to the following processes, such as an erector degree, is attained.
[0081] Thus, although there are many I/O wiring for a precharge signal (NRS) or precharge circuit driving signals (NRG) and input/output terminals as compared with the case (refer to drawing 5 and drawing 6) where the shift register 303 of the one above-mentioned sequence is used when using shift register 303' of two or more sequences, the advantage in the gestalt of this operation to the Prior art by in addition making an inspection circuit and a precharge circuit serve a double purpose is not lost.
[0082] (2-1) Carry out normal operation of the data-line drive circuit 101 and the scanning-line drive circuit 104 in opening or open-circuit inspection, in this case drawing 7 of the data line.
[0083] namely, -- and predetermined voltage called 5V is impressed to the picture signal line 304, making a precharge circuit driving signal (NRG2) into a low level, making two or more TFT202 of NRG1 sequence in the precharge circuit 202 into an ON state (namely, -- being high-level in a precharge circuit driving signal (NRG1) -- carrying out), and making two or more TFT202 of NRG2 sequence into an OFF state first Then, when two or more TFT301 which can set the predetermined voltage impressed to the picture signal line 304 to a sampling circuit 301 is turned on one by one by the sampling circuit driving signal Sn (n= 1, 2, --) and each data line 35 and each picture signal line 304 are made into switch-on, current flows to the precharge signal line 204 corresponding to NRG1 sequence. Then, the existence of opening or the open circuit in each data line 35 corresponding to NRG1 sequence can be judged by comparing with the reference current obtained when the current which flows to this precharge signal line 204 is measured and data-line 35 grade is in a normal state.
[0084] Next, two or more TFT202 of NRG2 sequence in the precharge circuit 202 is made into an OFF state. (namely, a precharge circuit driving signal (NRG1) -- a low level -- carrying out) and namely, -- predetermined voltage called 5V is impressed to the picture signal line 304, making high-level a precharge circuit driving signal (NRG2), making two or more TFT202 of NRG2 sequence into an ON state The existence of opening or the open circuit in each data line 35 corresponding to NRG2 sequence can be judged like the case of NRG1 above-mentioned sequence.
[0085] (2-2) the shunt evaluation of the data line -- in this case, stop operation of the scanning-line drive circuit 104 first and drawing 7 -- setting -- TFT302 of a sampling circuit 301 -- all -- an OFF state -- carrying out (that is, letting start signal DX of a shift register be a low level) -- TFT202 of the precharge circuit 201 -- predetermined voltage is impressed between the precharge signal lines which adjoin each other, making high-level a precharge circuit driving signal (NRG1 and NRG2) namely,, making all into an ON state Specifically, while making it the high level of 12V, the precharge signal line 204 corresponding to the precharge signals NRS2 and NRS4 is made into the low level of 0V for the precharge signal line 204 corresponding to the precharge signals NRS1 and NRS3. Then, although predetermined voltage is impressed to the data line 35 from the precharge signal line 204 through TFT202, since TFT302 is turned off altogether, the data line 35 which adjoins each other is insulated mostly mutually, and current should not flow among these precharge signal lines 204 that adjoin each other. then, it can set to each data line 35 by comparing with the reference current obtained when the current which flows between the precharge signal lines 204 which adjoin each other is measured and data-line 35 grade is in a normal state in this state (close to about 0) -- simplistic -- existence can be judged
[0086] (2-3) leak inspection of TFT of a sampling circuit -- in this case, operation of the scanning-line drive circuit 104 is stopped first -- making -- drawing 7 -- setting -- TFT302 of a sampling circuit 301 -- let all be an OFF state (that is, let start signal DX of a shift register be a low level)
[0087] namely, -- and predetermined voltage called 12V is impressed to the picture signal line 304, making a precharge circuit driving signal (NRG2) into a low level, making two or more TFT202 of NRG1 sequence in the precharge circuit 202 into an ON state (namely, -- being high-level in a precharge circuit driving signal (NRG1) -- carrying out), and making two or more TFT202 of NRG2 sequence into an OFF state first Then, since all of TFT302 switch of a sampling circuit 301 are turned off, as for the predetermined voltage impressed to the picture signal line 304, current should not flow to the precharge signal line 204 through the data line 35 and TFT202. Then, the existence of the leak in each TFT302 of the sampling circuit 301 corresponding to NRG1 sequence can be judged by comparing with the reference current obtained when the current which flows to the precharge signal line 204 is measured and the TFT302 grade of a sampling circuit 301 is in a normal state in this state (close to about 0).
[0088] Next, two or more TFT202 of NRG2 sequence in the precharge circuit 202 is made into an OFF state. (namely, a precharge circuit driving signal (NRG1) -- a low level -- carrying out) and namely, -- predetermined voltage called 12V is impressed to the picture signal line 304, making high-level a precharge circuit driving signal (NRG2), making two or more TFT202 of NRG2 sequence into an ON state The existence of the leak in each TFT302 of the sampling

circuit 301 corresponding to NRG2 sequence can be judged like the case of NRG1 above-mentioned sequence.
[0089] (2-4) leak inspection of TFT of a precharge circuit -- in this case, stop operation of the scanning-line drive circuit 104 first and drawing 7 -- setting -- TFT302 of a sampling circuit 301 -- all -- an ON state -- carrying out (that is, start signal DX of a shift register being made high-level) -- TFT202 of the precharge circuit 201 -- predetermined voltage called 12V is impressed to the picture signal line 304, making a precharge circuit driving signal (NRG1 and NRG2) into a low level, making all into an OFF state namely, -- Then, since all of TFT202 switch of the precharge circuit 302 are turned off, as for the predetermined voltage impressed to the picture signal line 304, current should not flow to the precharge signal line 204 through TFT302 and the data line 35. Then, the existence of the leak in each TFT202 of the precharge circuit 201 can be judged by comparing with the reference current obtained when the current which flows to the precharge signal line 204 is measured and the TFT202 grade of the precharge circuit 201 is in a normal state in this state (close to about 0).
[0090] As mentioned above, like the assembler to liquid crystal equipment 200, the precharge [inspection-cum-] circuit 201 in the gestalt of this operation has a checking feature in the case of inspection carried out a front, in front of a scribe process, etc., and has a precharge function in the case of the normal operation after the assembly to liquid crystal equipment 200. For this reason, as compared with the case where an inspection circuit and a precharge circuit are separately established in a part for the periphery of a substrate like before, the field on a substrate required in order to realize these two functions is notably small, and ends. Since it is not necessary to form the checking terminal and checking wiring which become unnecessary like before especially at the time of normal operation in exclusive use and the I/O wiring for precharge, an input/output terminal, etc. can be used also [checking], it is very advantageous. Furthermore, since it has a bad influence on the liquid crystal equipment which the checking terminal which became unnecessary like before corroded, and incorporated an active-matrix substrate and this concerned or possibility that aggravation of a checking circuit or checking wiring will lead to the aggravation as a whole active-matrix substrate and whole liquid crystal equipment concerned is reduced, it is doubly advantageous.
[0091] (The whole liquid crystal equipment composition) Next, the whole liquid crystal equipment example of composition equipped with the active-matrix substrate including the precharge [inspection-cum-] circuit 201 explained above is explained with reference to drawing 9 and drawing 10 . It is the plan with which drawing 9 looked at liquid crystal equipment from the opposite substrate side here, and drawing 10 is the H-H' cross section of drawing 9 .
[0092] the seal which sticks both substrates on the TFT array substrate 1 in drawing 9 and drawing 10 in the circumference of the screen-display field (namely, field of the liquid crystal equipment with which a picture is actually displayed by the orientation change of state of the liquid crystal layer 50) specified by two or more pixel electrodes 11, and surrounds the liquid crystal layer 50 -- the sealant 52 which consists of a photoresist as an example of a member is formed along the screen-display field And the circumference abandonment 53 of shading nature is formed between the screen-display fields and sealants 52 on the opposite substrate 2.
[0093] When put into the TFT array substrate 1 by the case of shading nature which opening was able to open behind corresponding to the screen-display field, the circumference abandonment 53 so that a screen-display field may not hide in the edge of opening of a case according to a manufacture error etc. That is, it is formed from a band-like shading nature material which has width of face of 500 micrometers or more in the circumference of a screen-display field so that the gap of about hundreds of micrometers to the case of the TFT array substrate 1 may be permitted, for example. Such circumference abandonment 53 of shading nature is formed in the opposite substrate 2 of sputtering, the photolithography, and etching which used metallic materials, such as Cr (chromium), nickel (nickel), and aluminum (aluminum). Or it is formed from material, such as resin black which distributed carbon and Ti (titanium) to the photoresist.
[0094] The data-line drive circuit 101 and the mounting terminal 102 are formed in the field of the outside of a sealant 52 along the lower side of a screen-display field, and the scanning-line drive circuit 104 is established in the both sides of a screen-display field along with two sides of right and left of a screen-display field. Furthermore, two or more wiring 105 for connecting between the scanning-line drive circuits 104 established in the both sides of a screen-display field is formed in the surface of a screen-display field. Moreover, in at least one place of the corner section of the opposite substrate 2, the fish eye 106 which consists of flow material for taking an electric flow between the TFT array substrate 1 and the opposite substrate 2 is formed. And the opposite substrate 2 with the almost same profile as a sealant 52 has fixed to the TFT array substrate 1 by the sealant 52 concerned.
[0095] Especially with the gestalt of this operation, the precharge [inspection-cum-] circuit 201 and the sampling circuit 301 are formed on the TFT array substrate 1 in the position which counters the circumference abandonment 53 of the shading nature formed in the opposite substrate 2, and the data-line drive circuit 101 and the scanning-line drive circuit 104 are formed on the narrow and long and slender periphery part of the TFT array substrate 1 which does not face the liquid crystal layer 50.

[0096] The precharge [inspection-cum-] circuit 201 and a sampling circuit 301 are circuits of an alternating current drive fundamentally at the time of normal operation. For this reason, even if it prepares these precharge [inspection-cum-] circuits 201 and sampling circuits 301 in TFT array substrate 1 portion which faces the liquid crystal layer 50 which was surrounded by the sealant 52 and pinched among both substrates, the problem of degradation of the liquid crystal layer 50 by direct-current-voltage impression is not produced. On the other hand, the data-line drive circuit 101 and the scanning-line drive circuit 104 are established in a part for the periphery of the TFT array substrate 1 which does not face the liquid crystal layer 50. Therefore, it can prevent beforehand that the direct-current-voltage component from the data-line drive circuit 101 or the scanning-line drive circuit 104 by which especially a direct-current drive is carried out leaks to the liquid crystal layer 50, and is impressed to it.

[0097] And it becomes easy to design these circumference circuits so that it can have a margin in a part for the periphery of the TFT array substrate 1, the scanning-line drive circuit 104 and the data-line drive circuit 101 can be formed in it by forming the precharge [inspection-cum-] circuit 201 and a sampling circuit 301 and it may meet under the circumference abandonment 53 in this way at specific specification.

[0098] With the gestalt of this operation, it is further prepared in the TFT array substrate 1 in the position which counters the circumference abandonment 53 also about the precharge signal line 204 and the precharge circuit driving-signal line 206 (refer to drawing 1). In this case, at the time of normal operation, the precharge [inspection-cum-] circuit 201 does not produce the problem of degradation of the liquid crystal by direct-current-voltage impression, even if it forms such a precharge signal line 204 and the precharge circuit driving-signal line 206 in TFT array substrate 1 portion which faces the liquid crystal layer 50, since it is the circuit of an alternating current drive fundamentally. And in this way, if two kinds of I/O wiring is formed in the bottom of the circumference abandonment 53, reduction of the effective screen product in liquid crystal equipment will not be caused.

[0099] (Details composition of liquid crystal equipment) Next, the concrete composition of each pixel section of liquid crystal equipment etc. is explained with reference to drawing 14 from drawing 11 . It is the plan of TFT with which drawing 11 is a plan of the pixel section with which liquid crystal equipment adjoins each other, and drawing 12 constitutes the precharge [inspection-cum-] circuit of liquid crystal equipment here. Moreover, drawing 13 is the cross section showing the B-B' cross section of the A-A' cross section and drawing 12 of drawing 11 , and drawing 14 shows the C-C' cross section of drawing 11 , and is a cross section in alignment with the precharge signal line wired under circumference abandonment of liquid crystal equipment. In addition, in order to make each class and each part material into the size of the grade which can be recognized on a drawing, scales are made to have differed for each class or every each part material in drawing 13 and drawing 14 .

[0100] As shown in the plan of drawing 11 , in the screen-display field, two or more pixel electrodes 11 are arranged in the shape of a matrix on the TFT array substrate 1, adjoin each pixel electrode 11, and TFT30 (field enclosed with the dashed line) is formed, and the data line 35, the scanning line 31, and capacity line 31' are prepared respectively along the boundary of the pixel electrode 11 in every direction. Electrical installation of the data line 35 is carried out to the source field of the semiconductor layer 32 through the contact hole 37, and it is controlled by the gate electrode which is a part of scanning line 31 in the channel field (the lower right of drawing 11 is ********) of the semiconductor layer 32. Electrical installation of the drain field of the semiconductor layer 32 is carried out to the pixel electrode 11 through the contact hole 38. Moreover, in order to add a storage capacitance to the pixel electrode 11, capacity line 31' is arranged. A storage capacitance forms as a dielectric the layer insulation layer (for example, gate insulating layer mentioned later) between 1st storage-capacitance electrode 32' and aforementioned capacity line (2nd storage-capacitance electrode) 31' which were installed from the drain field of the semiconductor layer 32. In addition, when forming capacity line 31' with a polysilicon contest film etc. at the same process as the scanning line, it is good to carry out electrical installation through the constant potential line 501 and contact hole 502 which consist of low resistance metal metallurgy group silicide, such as aluminum formed at the same process as the data line. By taking such composition, low resistance-ization of capacity line 31' is realizable. Moreover, if the constant potential line 501 is installed from the power supply supplied to the circumference circuit prepared around a screen-display field as shown in drawing 11 , and it is made to wire the field of the circumference abandonment 53, the miniaturization of liquid crystal equipment is realizable by it becoming unnecessary to prepare the external input terminal of exclusive use, and forming wiring in the field which was a dead space conventionally which is called the circumference abandonment 53 further.

[0101] Moreover, as shown in the plan of drawing 12 , in the precharge [inspection-cum-] circuit 201, the precharge signal line 204, the precharge circuit driving-signal line 206, and the data line 35 are arranged in parallel. Electrical installation of the precharge signal line 204 is carried out to the source field of each TFT202 through each contact hole 37", and electrical installation of the data line 35 is carried out to the drain field of each TFT202 through each contact hole 38." Moreover, opposite arrangement of the precharge circuit driving-signal line 206 is carried out through the

gate insulator layer as a gate electrode of TFT202 at the channel portion which connects these source fields and drain fields.

[0102] As shown in the A-A' cross-section portion of drawing 11 in the cross section of drawing 13 , liquid crystal equipment is set in the pixel section. The insulating layer 41 between the 1st layer by which the laminating was carried out the TFT array substrate 1 and on it, the semiconductor layer 32, the gate insulating layer 33, the scanning line 31 (gate electrode), Between the 2nd layer, between an insulating layer 42, the data line 35 (source electrode), and the 3rd layer, it has the insulating layer 43, the pixel electrode 11, and the orientation film 12, and TFT30 is formed for every pixel. Moreover, in the pixel section, liquid crystal equipment is equipped with the common electrode 21, the orientation film 22, and the shading film 23 by which the laminating was carried out the opposite substrate 2 which consists of a glass substrate, and on it, and is further equipped with the liquid crystal layer 50 pinched among both these substrates.

[0103] An insulating layer 43 consists of silicate glass films, such as NSG, PSG, BSG, and BPSG, a silicon nitride film, a silicon-oxide film, etc. between an insulating layer 42 and the 3rd layer between an insulating layer 41 and the 2nd layer between the 1st layer, respectively. The pixel electrode 11 consists of an opaque material with high reflection factors, such as transparent conductivity thin films, such as for example, an ITO film (indium teens oxide film), and aluminum. The orientation films 12 and 22 consist of organic thin films, such as for example, a polyimide thin film. The common electrode 21 consists of an ITO film etc., and it goes across it all over the opposite substrate 2, and it is formed. The shading film 23 is formed in the predetermined field which counters TFT30, is formed from a metallic material, resin black, etc. like the above-mentioned circumference abandonment 53, and has functions other than shading to the semiconductor layer 32 of TFT30, such as improvement in contrast, and color mixture prevention of color material. The liquid crystal layer 50 consists of liquid crystal which was formed when liquid crystal was enclosed with the space surrounded by the sealant 52 (refer to drawing 9 and drawing 10) between the TFT array substrate 1 and the opposite substrate 2 by vacuum suction etc., for example, mixed the pneumatic liquid crystal of a kind or some kinds. Sealants 52 are adhesives which consist of a photoresist or thermosetting resin, and the spacer for making distance between both substrates into a predetermined value is mixed.

[0104] TFT30 is equipped with the source field 34 formed in the gate insulating layer 33 which insulates the semiconductor layer 32 in which a channel is formed of the electric field from the scanning line 31 (gate electrode) and the scanning line 31, and the scanning line 31 and the semiconductor layer 32, and the semiconductor layer 32, the data line 35 (source electrode), and the drain field 36 formed in the semiconductor layer 32. One to which it corresponds of two or more pixel electrodes 11 is connected to the drain field 36. The source field 34 and the drain field 36 are formed by doping the object for the N type of predetermined concentration, or the dopant for P type to the semiconductor layer 32 like the after-mentioned according to whether the channel of N type or P type is formed.

[0105] The semiconductor layer 32 which constitutes TFT30 is formed by performing annealing processing and making the thickness of about 500-2000A carry out solid phase growth after forming an a-Si (amorphous silicon) film for example, on the insulating layer 41 between the 1st layer as a ground. In the case of P channel type TFT30, the aforementioned semiconductor layer 32 is doped with the ion implantation which used the dopant of V group elements, such as Sb (antimony), As (arsenic), and P (Lynn). Moreover, in the case of N channel type TFT30, the source field 34 and the drain field 36 are formed by doping with the ion implantation which used the dopant of III group elements, such as B (boron), Ga (gallium), and In (indium). Moreover, when setting TFT30 to N channel type TFT with LDD (Lightly Doped Drain Structure) structure, a low concentration dope field is formed in the part which adjoins a channel side among the source field 34 and the drain field 36, respectively by the dopant of V group elements, such as P (Lynn), and, similarly a high concentration dope field is formed by the dopant of V group elements, such as P (Lynn). Moreover, when referred to as P channel type TFT30, the source field 34 and the drain field 36 are formed using the dopant of III group elements, such as B (boron). In addition, TFT30 is good also as TFT of offset structure, and good also as self aryne type TFT. Moreover, N channel type TFT which can be written in at high speed is used for TFT30 for pixel switching in many cases.

[0106] Thus, that P channel type TFT and N channel type TFT form the liquid crystal equipment of the gestalt of this operation at the same process mostly on the TFT array substrate 1 which forms TFT30 for pixel switching can form the data-line drive circuit 101 and the circumference circuit of scanning-line drive circuit 104 grade on the same substrate as a pixel at the periphery of the outside of eye a possible hatchet and a screen-display field, as shown in drawing 9 . Thereby, it becomes unnecessary to carry out external [of the drive circuit], and becomes very advantageous to the miniaturization of cost and liquid crystal equipment.

[0107] The gate insulating layer 33 forms and obtains a thermal oxidation film with a comparatively thin thickness of about 300-1500A by oxidizing the semiconductor layer 32 thermally with the temperature of about 900-1300 degrees C. Or in order to prevent the warp of the substrate by heat, a silicon-oxide film and a silicon nitride film may be formed

on the aforementioned thermal oxidation film, and the multilayer gate insulating layer 33 may be formed.
[0108] After the scanning line 31 (gate electrode) deposits a polysilicon contest film by reduced pressure CVD etc., it is formed of a photolithography process, an etching process, etc. Or it may be formed from metal alloy films, such as high-melting point metal membrane metallurgy group silicide films, such as W (tungsten), Mo (molybdenum), and Ta (tantalum). in this case, if the shading film 23 arranges the scanning line 31 (gate electrode) as the part or the shading film which boils all and corresponds of a wrap field, it will also become possible to omit some or all of the shading film 23 by the shading nature which a metal membrane metallurgy group silicide film has In this case, there is an advantage which can prevent decline in the pixel numerical aperture by the lamination gap with the opposite substrate 2 and the TFT array substrate 1 especially.
[0109] You may form the data line 35 (source electrode) from transparent conductivity thin films, such as an ITO film, like the pixel electrode 11. Or you may form by sputtering processing etc. from metal alloy films, such as low resistance metal metallurgy group silicide, such as aluminum (aluminum) deposited on the thickness of about 1000-5000A. If the data line 35 is formed by the high film of shading nature like aluminum (aluminum), substitution of the shading film 23 in which the data line 35 was formed on the opposite substrate is attained, and there is an advantage which can prevent decline in the pixel numerical aperture by the lamination gap with the opposite substrate 2 and the TFT array substrate 1 also in this case.
[0110] Moreover, the contact hole 37 for carrying out electrical installation of the source field 34 of a semiconductor layer to the data line 35 is punctured by the insulating layer 42 between the 2nd layer. Furthermore, the contact hole 38 to the drain field 36 of a semiconductor layer is punctured by the insulating layer 43 between the 2nd correlation insulating layer 42 and the 3rd layer. Electrical installation of the pixel electrode 11 is carried out to the drain field 36 of a semiconductor layer through the contact hole 38 to the drain field 36 of this semiconductor layer. The above-mentioned pixel electrode 11 is formed in the upper surface of an insulating layer 43 between the 3rd layer constituted in this way.
[0111] TFT30 is adjoined and the storage capacitance 70 is added to the pixel electrode 11, respectively. 1st storage-capacitance electrode 32' in which this storage capacitance 70 was more specifically installed from the drain field 36 of the semiconductor layer 32, insulating-layer 33' formed of the same process as the gate insulating layer 33, and the capacity line 31 formed of the same process as the scanning line 31 -- ' (the 2nd storage-capacitance electrode) -- It consists of a part of pixel electrodes 11 which counter capacity line 31' through insulating layers 42 and 43 between the 2nd and the 3rd layer between insulating layers 42 and 43, the 2nd, and the 3rd layer. Thus, since the storage capacitance 70 is formed, even if duty ratio is small, a high definition display is enabled.
[0112] Next, as shown in the B-B' cross-section portion (left-hand side of drawing) of drawing 12 in the cross section of drawing 13 , TFT202 (refer to drawing 1) of the precharge [inspection-cum-] circuit 201 is formed in liquid crystal equipment every data line 35. this -- TFT -- 202 -- more -- concrete -- a semiconductor -- a layer -- 32 -- the same -- a process -- forming -- having -- a semiconductor -- a layer -- 32 -- " -- the gate -- an insulating layer -- 33 -- the same -- a process -- forming -- having -- the gate -- an insulating layer -- 33 -- " -- and -- the scanning line -- 31 -- the same -- a process -- forming -- having -- precharge -- a circuit -- a driving signal -- a line -- 206 -- having -- **** -- a semiconductor -- a layer -- 32 -- " -- **** -- TFT -- 30 -- a case -- the same -- a channel -- a field -- inserting -- the source -- a field -- 34 -- " -- and -- a drain -- a field -- 36 -- " -- preparing -- having -- the -- two -- a layer -- between -- an insulating layer -- 42 -- puncturing -- having had -- a contact hole -- 37 -- " -- and -- 38 -- " -- respectively -- leading -- a drain -- a field -- 36 -- And as for TFT202 with such a layer structure, in the position which counters the circumference abandonment 53 of the shading nature prepared in the opposite substrate 2, it is good to make it prepare on the TFT array substrate 1. Since the field of the circumference abandonment 53 which was a dead space conventionally can be used effectively by this, the miniaturization of liquid crystal equipment is realizable.
[0113] As shown in the cross section of drawing 14 , in the position which counters the circumference abandonment 53, the precharge signal line 204 and the precharge circuit driving-signal line 206 pass the insulating-layer 42 between the 2nd layer on two or more scanning lines 31 upper part. and these precharge signal lines 204 and the precharge circuit driving-signal line 206 were formed by metal thin films, such as aluminum in which almost all the portions were formed at the same process as the data line 35, -- low -- it is wiring [****] Thus, since the field which was a dead space conventionally by carrying out wiring formation of the precharge signal line 204 and the precharge circuit driving-signal line 206 can be used effectively for the field of the circumference abandonment 53, the miniaturization of liquid crystal equipment is realizable.
[0114] In addition, although not illustrated from drawing 11 to drawing 14 , TFT302 (refer to drawing 1) of a sampling circuit 301 is constituted like TFT202 of the precharge [inspection-cum-] circuit 201, and it is good to make it prepare on the TFT array substrate 1 in the position which counters the circumference abandonment 53 of the shading nature prepared in the opposite substrate 2. Thereby, since the occupancy area of the data-line drive circuit 101

is expandable, various functions liquid crystal equipment is realizable. Or it cannot be overemphasized that it is advantageous in case liquid crystal equipment is miniaturized.

[0115] In addition, although not shown in drawing 14 from drawing 11 , according to the exception of modes of operation, such as for example, TN (Twisted Nematic) mode, STN (super TN) mode, and D-STN (double-STN) mode, and the normally white mode / normally black mode, a polarization film, a phase contrast film, a polarizing plate, etc. are arranged in a predetermined direction at the side in which the incident light of the side in which the incident light of the opposite substrate 2 carries out incidence, and the TFT array substrate 1 carries out outgoing radiation, respectively. Moreover, you may form the light filter of RGB, a die clo IKKU filter, a micro lens, etc. in the opposite substrate 2 suitably. Furthermore, you may prepare the shading layer which becomes from a refractory metal also at the TFT30 bottom as indicated by the TFT array substrate 1 at JP,9-127497,A, JP,3-52611,B, JP,3-125123,A, JP,8-171101,A, etc.

[0116] The liquid crystal equipment of the gestalt of this operation is applicable to various kinds of liquid crystal material (liquid crystal phase), a mode of operation, a liquid crystal array, the drive method, etc.

[0117] (Electronic equipment) Next, the gestalt of operation of electronic equipment equipped with the liquid crystal equipment 100 in the gestalt of the operation explained to the detail above is explained with reference to drawing 18 from drawing 15 .

[0118] The outline composition of the electronic equipment which equipped drawing 15 with liquid crystal equipment 100 and its drive circuit 1004 is shown first.

[0119] In drawing 15 , electronic equipment is equipped with the source 1000 of a display information output, the display information processing circuit 1002, the drive circuit 1004, liquid crystal equipment 100, the clock generation circuit 1008, and a power circuit 1010, and is constituted. The source 1000 of a display information output outputs display information, such as a picture signal of a predetermined format, to the display information processing circuit 1002 based on the clock signal from the clock generation circuit 1008 including the tuning circuit which aligns and outputs memory, such as ROM (Read Only Memory), RAM (Random Access Memory), and an optical disk unit, and a picture signal. The display information processing circuit 1002 is constituted including various well-known processing circuits, such as amplification / inversion circuit, a phase expansion circuit, a rotation circuit, a gamma correction circuit, and a clamping circuit, generates a digital signal one by one from the display information inputted based on the clock signal, and outputs it to the drive circuit 1004 with a clock signal CLK. The drive circuit 1004 drives liquid crystal equipment 100. A power circuit 1010 supplies a predetermined power supply to each above-mentioned circuit. In addition, on the TFT array substrate which constitutes liquid crystal equipment 100, the drive circuit 1004 may be carried and, in addition to this, the display information processing circuit 1002 may be carried.

[0120] Next, the example of the electronic equipment constituted in this way from drawing 16 by drawing 18 is shown, respectively.

[0121] In drawing 16 , an example slack liquid crystal projector 1100 of electronic equipment prepares three liquid crystal modules containing the liquid crystal equipment 100 with which the drive circuit 1004 mentioned above was carried on the TFT array substrate, and is constituted as a projector used as light valves 100R, 100G, and 100B for RGB, respectively. In a liquid crystal projector 1100, if an incident light is emitted from the lamp unit 1102 of the white light sources, such as a metal halide lamp, it will be divided into the optical components R, G, and B corresponding to the three primary colors of RGB by the mirror 1106 of three sheets, and the dichroic mirror 1108 of two sheets, and will be led to the light valves 100R, 100G, and 100B corresponding to each color, respectively. Under the present circumstances, especially B light is drawn through the relay lens system 1121 which consists of the incidence lens 1122, a relay lens 1123, and an outgoing radiation lens 1124, in order to prevent the optical loss by the long optical path. And after the optical component corresponding to the three primary colors modulated by light valves 100R, 100G, and 100B, respectively is again compounded with a dichroic prism 1112, it is projected by the screen 1120 as a color picture through a projector lens 1114.

[0122] In drawing 17 , other personal computers 1200 of the laptop type dealing with example slack multimedia of electronic equipment (PC) are equipped with the main part 1204 with which the keyboard 1202 was incorporated while it has liquid crystal equipment 100 mentioned above in the top covering case and they hold CPU, memory, a modem, etc. further.

[0123] moreover, as shown in drawing 18 , in the case of the liquid crystal equipment 100 which carries neither the drive circuit 1004 nor the display information processing circuit 1002 To TCP (Tape Carrier Package)1320 mounted on the polyimide tape 1322, IC1324 including the drive circuit 1004 or the display information processing circuit 1002 It is also possible to connect physically and electrically through the anisotropy electric conduction film prepared in the periphery of the TFT array substrate 1, and to carry out production, sale, use, etc. as liquid crystal equipment 100.

[0124] ****** equipped with the video tape recorder of a liquid crystal television, a viewfinder type, or a monitor

direct viewing type, the car navigation equipment, the electronic notebook, the calculator, the word processor, the engineering workstation (EWS), the cellular phone, the TV phone, POS terminal, and touch panel other than electronic equipment which were explained with reference to drawing 18 from drawing 16 above etc. is mentioned as an example of the electronic equipment shown in drawing 15 .

[0125]

[Effect of the Invention] According to the active-matrix substrate of this invention, a precharge [inspection-cum-] circuit Since the assembler to liquid crystal equipment has a checking feature in the case of inspection carried out a front, in front of a scribe process, etc. and has a precharge function in the case of the normal operation after the assembly to liquid crystal equipment As compared with the case where an inspection circuit and a precharge circuit are separately established in a part for the periphery of a substrate like before, a substrate top field required in order to realize these two functions is notably small, and ends. Since it is not necessary to form the checking terminal and checking wiring which become unnecessary like before especially at the time of normal operation in exclusive use and the I/O wiring for precharge, an input/output terminal, etc. can be used also [checking], it is very advantageous.

[0126] According to liquid crystal equipment and electronic equipment of this invention, since various kinds of electrical property inspection is ensured, it is reliable, and a circumference circuit can be designed in high specification with a margin, and reliable high-definition operation can be performed. Furthermore, the miniaturization of the whole equipment is also possible.

[0127] According to the inspection method of the active-matrix substrate of this invention, various kinds of electric inspection, such as opening or open-circuit inspection, and shunt evaluation, can be ensured comparatively easily.

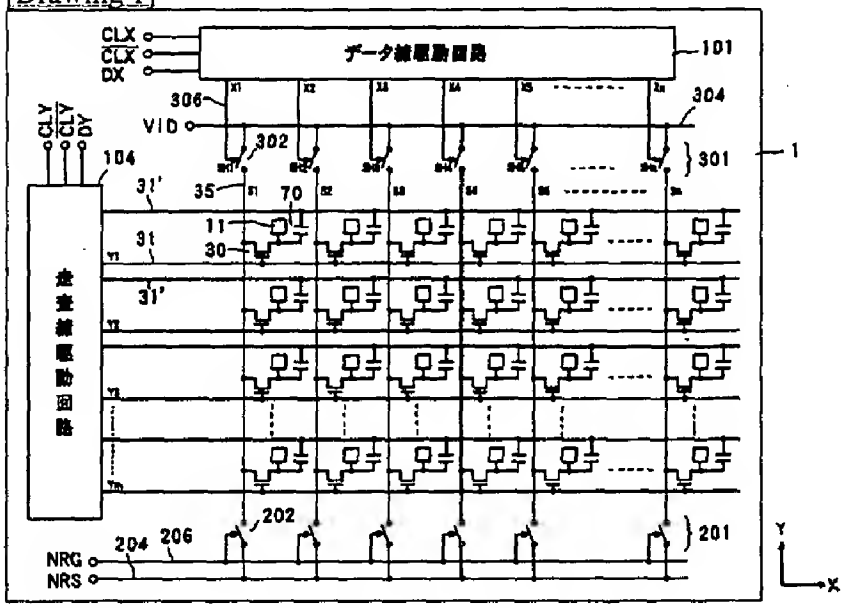
[Translation done.]

* NOTICES *

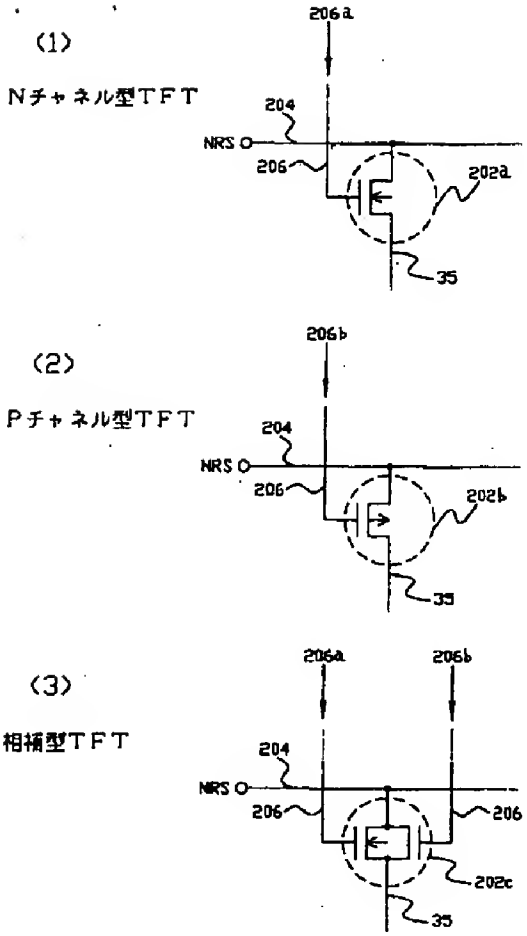
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

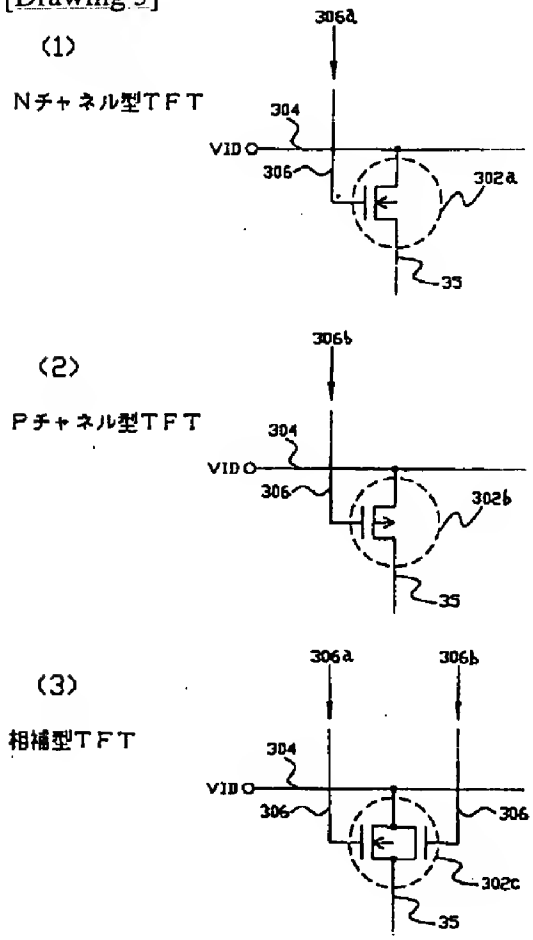
[Drawing 1]



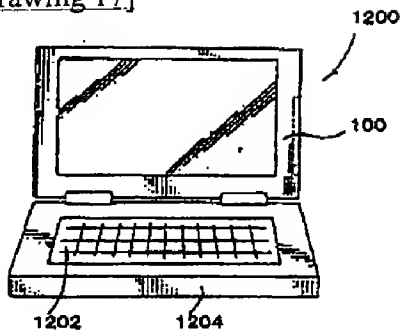
[Drawing 2]


(1)
Nチャネル型TFT
206a
204
NRS
206
202a
35
(2)
Pチャネル型TFT
206b
204
NRS
206
202b
35
(3)
相補型TFT
206a
206b
204
NRS
206
206
202c
35

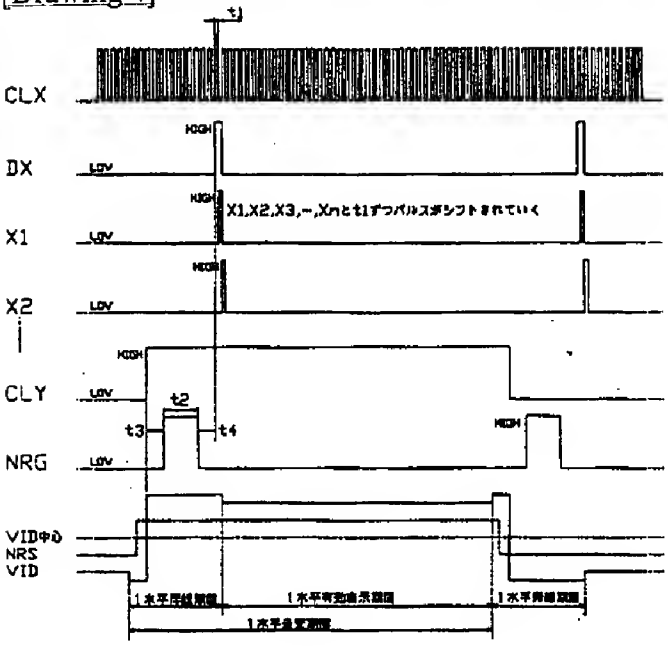
[Drawing 3]


(1)
Nチャネル型TFT
306a
304
VID
306
302a
35
(2)
Pチャネル型TFT
306b
304
VID
306
302b
35
(3)
相補型TFT
306a
306b
304
VID
306
306
302c
35

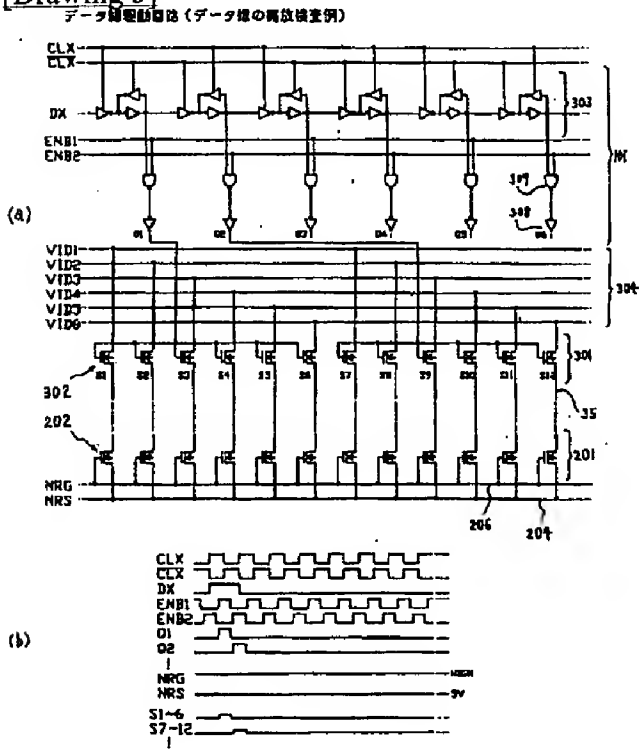
[Drawing 17]



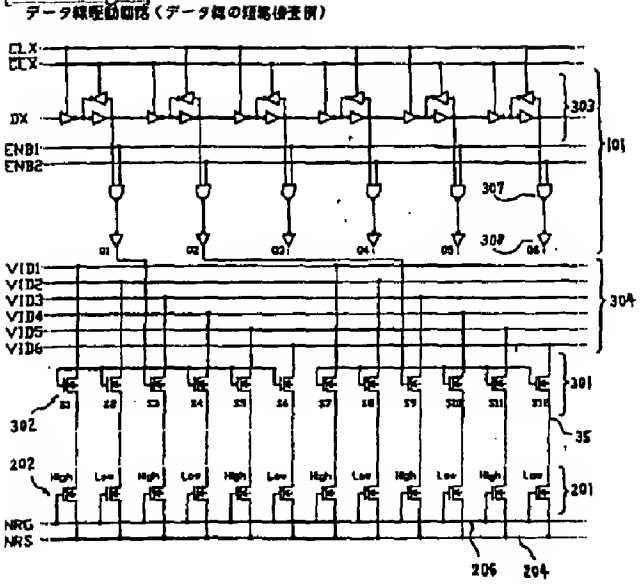
[Drawing 4]



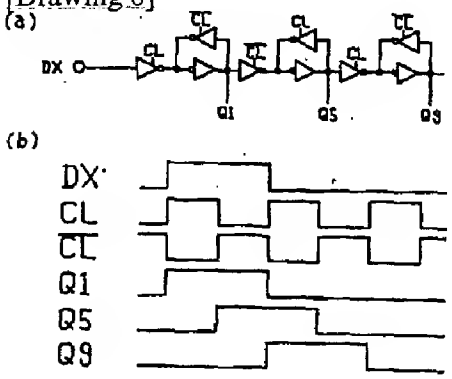
[Drawing 5]



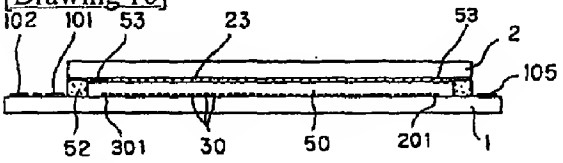
[Drawing 6]



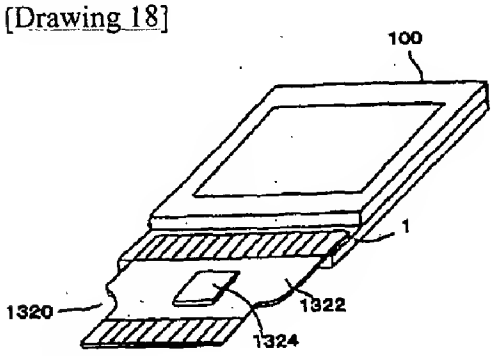
[Drawing 8]



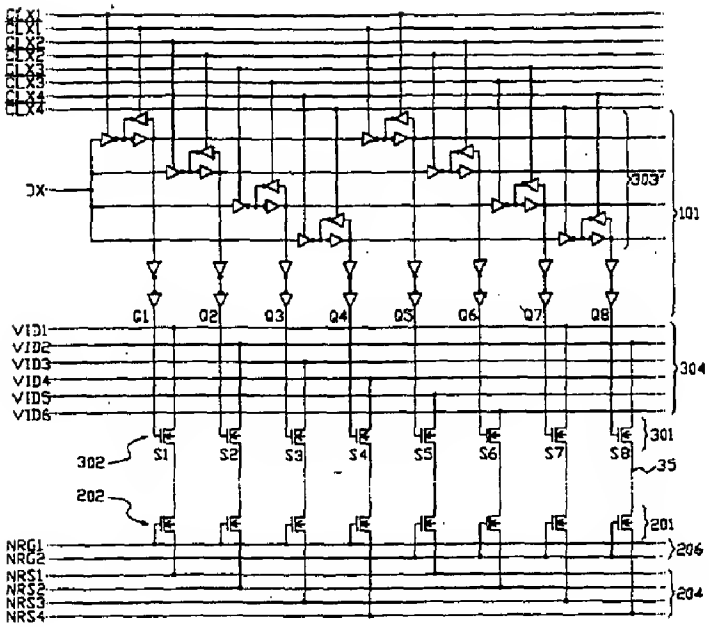
[Drawing 10]



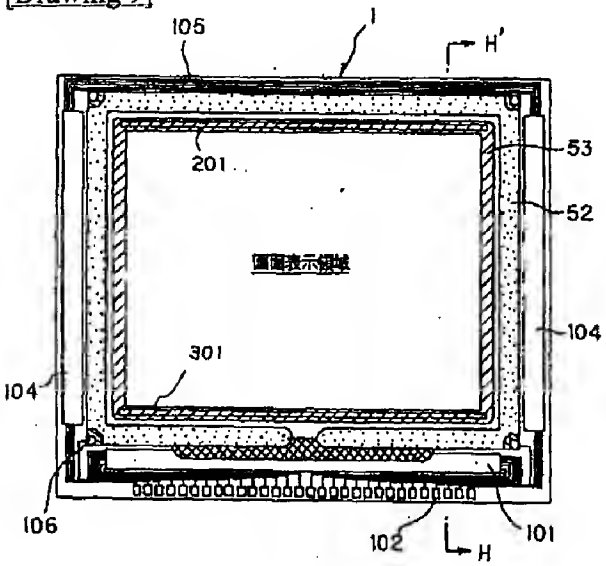
[Drawing 18]



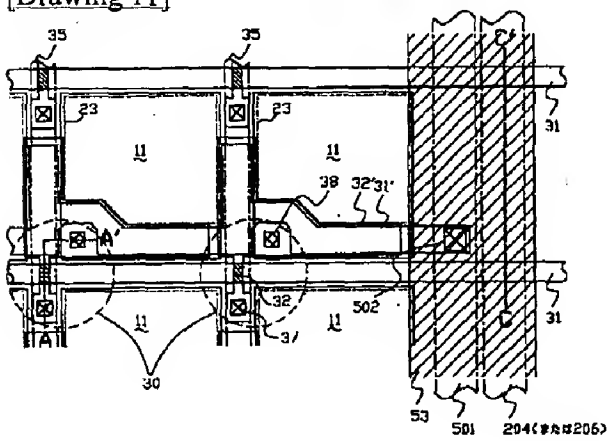
[Drawing 7]



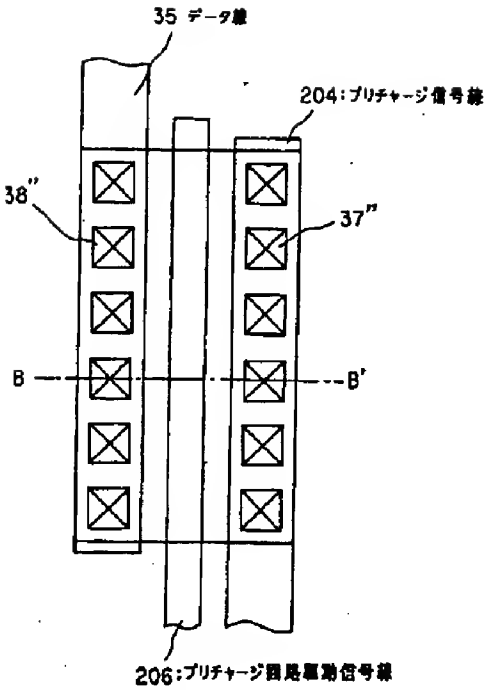
[Drawing 9]



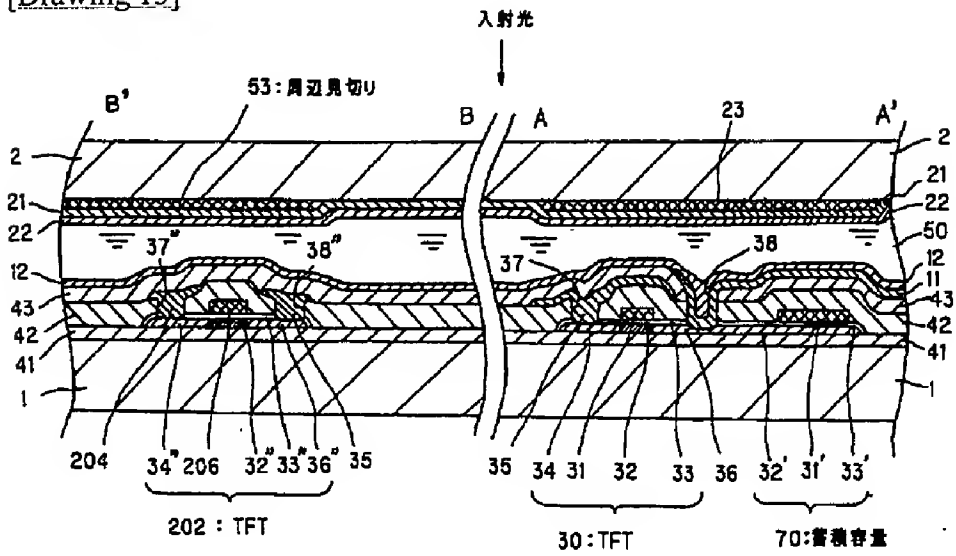
[Drawing 11]



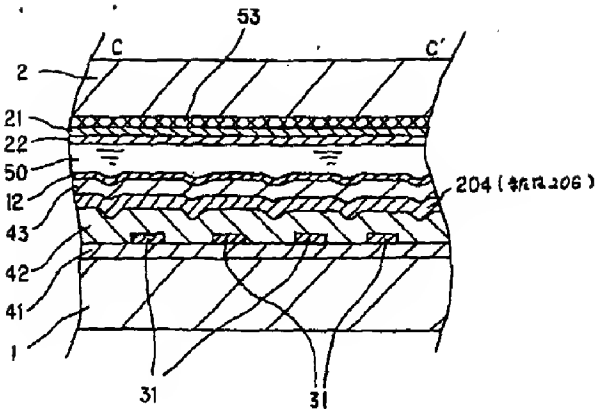
[Drawing 12]



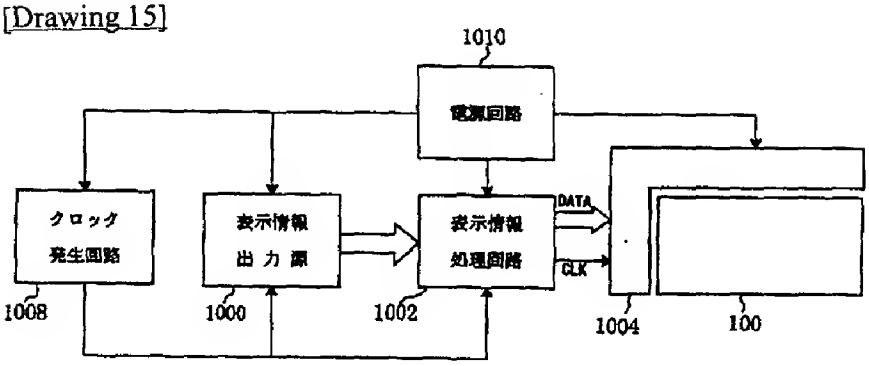
[Drawing 13]



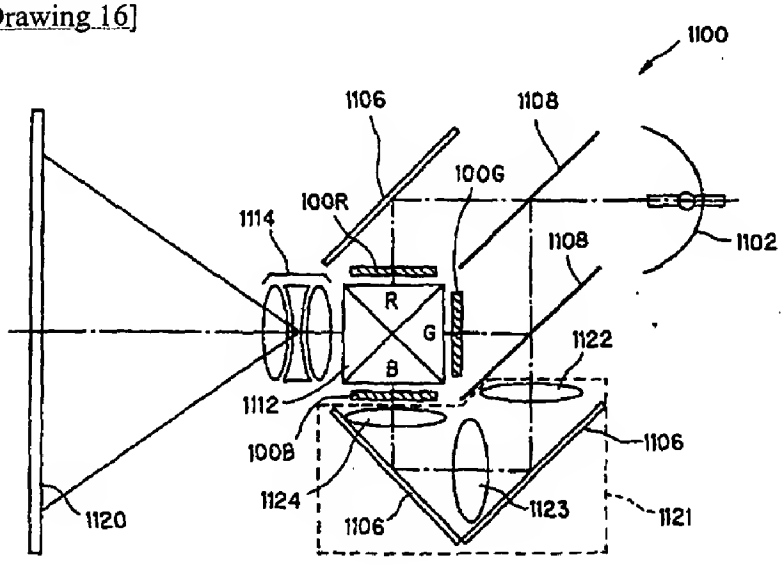
[Drawing 14]



[Drawing 15]



[Drawing 16]



[Translation done.]